A SYSTEM OF SURGERY

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IN THREE VOLUMES

VOLUME II

With 20 Colour Plates, 10 Half-tone Plates
and 336 Figures in the Text



CASSELL AND COMPANY LTD
London, New York, Toronto and Melbourne
1925

First Edition *September* 1912.
Reprinted January 1914, *January* 1915
Second Edition *June* 923.
Reprinted October 1923.

Printed in Great Britain

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A SYSTEM OF SURGERY

THE BREAST

By W SAMPSON HANDLEY, M S, F R C S

ANATOMY OF THE BREAST

The mamma is an organ developmentally arising from the skin intercalated in the thickness of the subcutaneous fat and probably representing a highly developed group of sebaceous follicles. It is firmly attached to the skin at the nipple and is connected to it at numerous other points by fibrous septa called the suspensory ligaments of Astley Cooper The size of the breast is no index to its secreting power since prominent mammæ often consist mainly of fat

Each mamma consists of from twelve to twenty lobes which are really separate sector-shaped glands, packed closely together in one plane their ducts converging upon the nipple and opening by separate orifices upon its summit The autonomy of each lobe is an important fact since disease of one or more of the lobes is thereby hindered from spreading to the adjoining ones. In some cases of disease a sector-shaped tumour may be observed mapping out the limits of the affected lobe or lobes It is possible sometimes to excise the diseased lobes of the breast without interfering with the healthy ones. The main duct of each lobe before opening upon the nipple is dilated to form a small reservoir or ampulla [illegible] to [illegible] in in diameter the undue distension of which may give rise to galactocele or if lactation is not in progress to a retention cyst containing serous fluid Each lobe of the breast is composed of a number of lobules which bear to the main duct of the lobe the relation of a bunch of grapes to its stalk. A lobule of the breast consists of a small milk-duct surrounded by a group of acini or alveoli the blind glandular recesses which discharge their secretions

into the duct. A large amount of fibro-fatty tissue intervenes between the lobules, and serves to cushion and protect them. In microscopic sections the ducts are distinguished by their single lining of columnar epithelium, while the alveolar or secreting epithelium is cubical. The epithelium of the alveoli and ducts rests upon a basement membrane of flattened endothelial cells. In microscopic sections, breast tissue can be recognized by these characteristic groups of cubical-celled alveoli containing one or more columnar-celled ducts. The intervening fibrous and fatty tissue contains here and there the section of a larger duct, the whole presenting a characteristic histological picture.

Limits of the mamma.—Stiles showed that the outlying lobules of the breast extend as a thin marginal fringe in the subcutaneous fat considerably beyond the limits of the mammary prominence. Including these outlying portions, the vertical diameter of the breast extends from the lower border of the second rib to the sixth costal cartilage at the angle where it begins to sweep upwards to the sternum. Its horizontal diameter extends from a little within the edge of the sternum, opposite the fourth rib to the fifth rib in the mid-axillary line. The lower and inner margin of the breast overlies the sixth costal cartilage midway between the angle and its sternal end, and is situated only about an inch from the dangerous area in breast cancer—the area of *epigastric invasion*.

In a majority of cases a tongue-shaped projection of breast tissue, known as the *axillary tail*, extends to the base of the axilla, under cover of the lower edge of the great pectoral. Frequently the axillary tail lies in almost direct contact with the lowest of the axillary lymphatic glands.

Relations to the underlying muscles.—Roughly speaking the upper and inner two-thirds of the breast rests on the great pectoral muscle. The lower and outer third of the breast lies mainly on the serratus magnus—a fact often unwisely ignored in the operation for cancer. At its periphery the breast rests to a small extent below upon the aponeurosis of the external oblique and the origin of the rectus, externally upon some of the digitations of the external oblique. A portion of the breast, and especially its axillary tail, rests against the lower part of the inner wall of the axilla and is separated from the axillary glands only by a fatty and ill-defined portion of the axillary fascia. Hence in this region the distinction between an enlarged axillary gland and an indurated portion of breast tissue may be difficult to make. The muscular relations of the breast are of great importance in the operation for breast cancer for every muscle which directly touches the affected organ is very likely to be infected by microscopic secondary growths quite early in the case

Moreover the thinner the muscular layer which separates the primary growth from the pleural cavity the greater the probability of early pleural invasion Thus in outlying mammary growths the prognosis is worse than in the case of growths which are separated from the underlying ribs by the thickness of the great pectoral muscle Portions of the glandular tissue of the breast are sometimes found beneath the pectoral fascia in the substance of the great pectoral muscle.

Blood supply —The arteries which supply the mammary gland are branches of the internal mammary long thoracic superior thoracic, and perforating branches from the second third and fourth intercostal arteries. It has been shown that the important perforating branches of the internal mammary artery for the most part turn round the margin of the breast and spread out upon its superficial aspect before penetrating its substance. Thus, the breast may be extensively stripped up from the pectoral muscle without interfering with its blood supply—a fact of surgical importance (see p 42)

Lymphatic vessels—The breast is richly supplied with lymphatic vessels. Each lobule possesses its own system of minute lymphatic capillaries which come into close relation with the acini Many of the lymphatic vessels of the breast pass into or communicate with the pectoral lymphatic plexus which lies on the pectoral fascia in immediate contact with the posterior surface of the mamma. On the anterior surface of the breast a plexus of large lymphatic vessels is present beneath the skin of the areola (subareolar plexus of Sappey) The normal lymph drainage of the breast flows almost exclusively to the axillary glands of the same side. Large lymphatic trunks connect the pectoral lymphatic plexus and the subareolar plexus with the lower glands upon the internal wall of the axilla. It is, however a mistake to regard the pectoral lymphatic plexus as an anatomical entity It is in reality merely a conventional subdivision of the deep fascial lymphatic plexus (Fig 246) whose network of intercommunicating channels forms a single system investing the entire body The unity of the plexus is a fact of capital importance in the pathology of breast cancer for it allows the indefinite spread of the process of permeation (see p. 61) This great plexus is divisible by the median plane of the body and by two horizontal planes, passing through the umbilicus and the clavicles respectively into six catchment areas three on each side which drain respectively into the cervical, the axillary and the inguinal glands Within each area a special set of trunk lymphatics arises from the plexus and converges on the corresponding set of glands. These trunk vessels are of such a size that fine particles, such as cancer cells may be swept along them by the current, to lodge in the corresponding glands. But in

the boundary zones of the catchment areas no trunk lymphatics are present. Here are found only narrow tortuous channels, not navigable by floating cancer cells, and only to be penetrated by the slower process of permeation.

One lymphatic trunk deserves especial mention It arises on the posterior aspect of the breast and pierces the great pectoral muscle to terminate in the subclavian lymphatic glands, without passing first into the lower lymphatic glands of the axilla. Consequently in breast cancer the subclavian glands may be found enlarged before the lower axillary glands have become affected

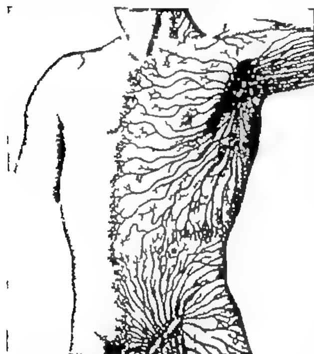


Fig 246 —The trunks of the fascial plexus. The fine meshwork of vessels constituting the plexus itself is only partially indicated in this figure.

(After Sappey's Vaisseaux Lymphatiques.)

The subclavian glands themselves are of great surgical importance They are situated just below the clavicle internally to the first part of the axillary artery and vein and shielded in front by the great pectoral muscle and by the costo-coracoid membrane Owing to their sheltered position they are very likely to escape removal at the hands of an inexpert operator for breast cancer Their efferent vessels form *the afferents of the supraclavicular glands* which are the next set to be involved in breast cancer

Anterior mediastinal glands.—It has been sometimes stated that efferent lymphatic vessels from the breast pass to the retrosternal chain of glands which accompanies the internal mammary artery It is doubtless true that there is a mediate communication between the breast and these glands by way of the pectoral lymphatic plexus and of the perforating branches which run from that plexus to

the glands in question But fortunately these perforating branches must be regarded not as true afferent lymphatics but as anastomotic channels of small diameter and sluggish stream along which embolic transport of cancer cells cannot occur though they may be invaded by permeation Torök and Wittelshöfer found infection of the anterior mediastinal glands recorded in only 0·5 per cent of necropsies for breast cancer but statistics of recurrence after the modern operation are decisive that these glands are frequently the port of entry of the disease into the thorax, and that they are often already microscopically infected in "operable" cases. Stibbe has recently reinvestigated the anatomy of these glands. They are rarely found below the fourth space and are usually four or five in number In a case of lympho-sarcoma I have seen a gland continuing this chain as far as the base of the ensiform cartilage and resting upon the diaphragm

The anterior mediastinal glands lie about half an inch outside the margin of the sternum in front of the internal mammary vessels which separate them from the pleura, here very thin. In the lower spaces the triangularis sterni also intervenes between the glands and the pleura.

Supraclavicular glands.—The modern operation for breast cancer while almost abolishing local recurrence, has in many cases not prevented ultimate recurrence in regions beyond the range of the operation. The facts of recurrence show that in many operable cases microscopic deposits are already present in the anterior mediastinal or the supraclavicular glands, or in both. The first of the supraclavicular glands to be enlarged is generally a gland situated deep in the angle between the sterno-mastoid muscle and the clavicle almost behind the latter Unless this fact is known, early supraclavicular infection will probably be overlooked. The importance of supraclavicular infection depends mainly upon the relation of the glands to the brachial plexus, the pleura, and the deep lymphatic chain of the neck. Owing to these relations, agonizing brachial neuralgia, pleural infection or cerebral secondary deposits may result. It is an urgent question how short of excision of the glands, microscopic early infection of the supraclavicular glands, inappreciable clinically can be dealt with.

Lymphatic communication between the breasts.—It will be clear from the preceding description that the lymphatic systems of the two breasts communicate across the middle line indirectly through the medium of the fine vessels of the fascial plexus. Cancer can thus only spread to the opposite breast in a late stage and after permeation has crossed the middle line, an event which is usually signalized by embolic invasion and enlargement of the opposite axillary glands. This embolic glandular enlargement precedes cancerous deposit in the opposite breast.

Lymphatic arrangements of the skin.—It was formerly thought that breast cancer spread in the plane of the skin along a hypothetical plexus described by Arnold situated at the junction of the corium and subcutaneous tissue, and called the deep cutaneous plexus. Accordingly the removal of a very large area of skin was considered imperative. Both the deep cutaneous and the more superficial subpapillary plexus would appear according to my own observations, to be figments of the imagination. The only communication between adjoining lymphatic areas of skin appears to be by way of the fascial lymphatic plexus. Hence the nodular discontinuous character of carcinomatous infection of the skin. It is due to up-stream permeation of the cutaneous tributaries of the fascial plexus. Cancer does not spread along the skin itself to any material extent.

From the muscles small tributaries reach the fascial plexus on its deep aspect. Up-stream permeation of these tributaries is responsible for the muscular nodules which may occur in a late stage of cancer in the pectorals, the serratus magnus, the deltoid the rectus abdominis, the intercostals, or other muscles which lie within the area of permeation.

Development.—The breasts remain small and unimportant until puberty. Up to this age and permanently in the male breast, the characteristic alveoli are absent and the minute milk-ducts terminate in blind end-sacs, lined by an epithelium which approximates in character to the columnar epithelium of the ducts. At puberty the alveoli are formed as hollow buds which grow outwards from the end-sacs into the surrounding tissues.

At two periods of life, normal activities of the mammary gland have been dignified with the name of mastitis.

1 During the first few days of life in either sex the breasts may become swollen and a few drops of serous fluid or of true milk may be discharged from the nipple (*mastitis neonatorum*). This mastitis of new born children, like the jaundice and the cutaneous hyperæmia which accompany it is probably due to the first onslaught of bacteria upon the aseptic babe the bacteria of the skin penetrating some distance along the ducts of the breast. It has no clinical importance and should be let alone unwise and active treatment such as massage, may prolong and aggravate the condition. A few rare cases are on record where infantile lactation has persisted for several weeks and in one case for over three months.

2 With the onset of puberty both in boys and in girls, the undeveloped breasts may become tender and swollen for some days or weeks (*mastitis adolescentium*). At the same time a scanty serous discharge exudes from the nipple, and the axillary glands become unduly palpable. No treatment is required for this condition which

derives its only importance from the parental anxiety it is apt to cause.

At puberty in the female, owing to the rapid development of the acini and the deposition of fat between the growing lobes the breast begins to assume its characteristic form and size The onset of pregnancy leads to further marked changes in the gland, for the details of which a work on obstetrics should be consulted. Many new alveoli are formed and the cell proliferation proceeds with such rapidity that until parturition initiates lactation the alveoli lose their lumina and consist of solid cords of cells, the breast becomes coarsely granular to the touch the skin of the areola dark and in the later months of pregnancy a watery fluid exudes from the nipple

The establishment of lactation is accompanied by general congestion and swelling of the breasts and sometimes by local tenderness and elevation of the temperature and soreness in the axillæ. These activities may easily pass into acute mastitis.

Involution.—When lactation is over the vascularity of the gland rapidly diminishes, and the lobules become much reduced in size and complexity by atrophy of their constituent alveoli. These changes make further progress at the climacteric. At this time also the fatty tissue of the breast often atrophies, while its fibrous tissue, increasing in amount, contracts upon and causes gradual atrophy or even complete disappearance of many of the glandular alveoli. The characteristic withered and flattened breast of old age is thus produced

DEVELOPMENTAL ABNORMALITIES

AMASTIA AND POLYMASTIA

In very rare cases one or both of the breasts are congenitally absent—a condition known as *amastia* or *amazia*. A rudimentary nipple is usually present. The condition is often associated with absence or rudimentary development of the sternal portion of the great pectoral muscle, and, less commonly with other malformations.

Polymastia is a condition in which extra breasts or extra nipples are present, usually below the normal nipple. A supernumerary breast may or may not have a nipple, and is usually functionless, but may secrete milk during lactation. Polymastia is more frequent in men than in women. Mitchell Bruce, among 4,000 individuals examined, found 47 males and 14 females with supernumerary nipples. The accessory structures are most often found along a line leading from the axilla downwards and inwards to a point a few inches above the umbilicus. A case has been recorded in which five breasts were present, four of them functional. The fifth and lowest was median, and situated 5 in. above the umbilicus. Champneys has shown that during pregnancy the axillary sebaceous glands frequently become enlarged and lumpy and that occasionally true milk may be expressed from the hypertrophied glands. Bryant has pointed

out that certain cases of carcinoma resembling breast cancer, but primary in the axilla, may originate from such abnormal sebaceous glands.

HYPERPLASIA OR HYPERTROPHY OF THE BREASTS

This is a rare affection met with both in single and in married women, and is usually bilateral (Fig. 247). In the most marked cases the breasts



Fig 247 —Hypertrophy of the breasts.
(Beatson, Edin. Med. Journ Dec 908.)

within a few months may attain such an enormous size that they become a serious encumbrance, causing pain, dyspnœa, and palpitation. In Esterle s case, quoted by Rodman, they attained a combined weight of 30 lb. within little more than three months. In Delfis' case, occurring in a pregnant woman, the mammæ rested upon the thighs when the patient sat down. The disease comes on most frequently about puberty or during pregnancy The cases associated with pregnancy though more rapid in their evolution, are favourable in this respect, that the hypertrophy may subside after

parturition, whereas in other cases it is permanent and usually progressive The enlargement depends upon a general overgrowth of the fibrous tissue of the mammae, but in the cases associated with pregnancy true glandular hypertrophy may be present.

Treatment.—Pressure mechanical support and the administration of iodides may suffice in the milder cases, but the only treatment which has proved effective in well-marked examples is amputation of the breasts. The operation should not be undertaken during pregnancy

GYNÆCOMASTIA

A unilateral or bilateral hypertrophic enlargement of the male breast to such a point that it resembles the virgin breast of the female is known as gynæcomastia. It may occur as part of a general tendency to the feminine type, in association with a high voice, and perhaps with developmental defects in the genital organs. It is said sometimes to follow removal of the testicles. It may be found in men of full sexual development. Histologically the breast resembles that of the virgin female.

Gynæcomastia probably predisposes to pathological changes. Thus, in a man, otherwise normal, who presented a slight degree of this condition, I observed bilateral chronic mastitis owing to the pressure of the braces upon the gland.

DISEASES OF THE NIPPLE AND AREOLA

RETRACTION OF THE NIPPLE

This condition is most often due to failure in the evolution of the child's rudimentary nipple towards the normal prominent adult type. The nipple may be merely flattened, or may be represented by a funnel like concavity at the centre of the areola. This condition is of importance because it produces inability to suckle and favours sepsis at the orifices of the milk-ducts. It may thus become a cause of milk congestion, acute mastitis and mammary abscess.

Acquired retraction of the nipple indicates a fibrotic process in the underlying breast tissue. It is an important sign of cancer depending upon the reactive or inflammatory processes associated with the growth. Less commonly retraction is associated with Paget's disease or depends upon scarring, the result of an abscess or a shrivelled cyst. Some authors incorrectly state that it occurs in chronic mastitis.

SIMPLE ECZEMA OF THE NIPPLE

May arise in the course of or apart from pregnancy or lactation and may be a cause of abscess of the breast. The *Staphylococcus pyogenes aureus* has been demonstrated in the discharge and may also be present in the milk during lactation

From Paget's disease of the nipple, simple eczema is distinguished by its amenability to treatment and by the fact that it is usually bilateral

while Paget's disease is invariably unilateral. Chancre of the nipple also is usually unilateral, though I have seen a bilateral case. In chancre a microscopic examination and the appearance of secondaries will decide the question.

Treatment.—Various ointments may be tried. Boric, lead subacetate and mild mercurial ointments are those most often used. If these fail and Paget's disease can be excluded a trial of vaccine treatment should be made after bacterial examination.

When eczema of the nipple occurs during lactation it is best to wean the child, both on the mother's account, because a mammary abscess is a likely sequel, and for the child's sake, because the milk is likely to contain staphylococci. Only if the eczema is very slight in degree can sanction be given for continued suckling, through a nipple shield. In such circumstances no poisonous ointments must be prescribed.

Cracked nipple is the term applied to a fissured condition of the skin of the nipple comparable to "chapped hands." It is usually associated with eczema of the nipple, and generally occurs during suckling. The treatment is the same as for eczema. The fissure should be touched with solid silver nitrate. For the prevention of cracked nipple see p. 17

The principal importance of cracked nipple is that it is the usual port of entry for an acute streptococcal lymphangitis which frequently terminates in a mammary abscess.

PAPILLOMA OF THE NIPPLE

This condition is sometimes met with, and the papilloma may attain a considerable size. Owing to the constant drag of the tumour on loose tissues, the larger examples of these tumours are pedunculated. In the course of years the pedicle may become long and attenuated, and pulsation may be felt in it. The tumour itself is usually globular and its surface lobulated and warty. Owing to septic changes the tumour may exude an offensive serous discharge or may ulcerate.

Treatment.—A sessile wart of the areola should be excised. A pedunculated wart should be strangulated by tying a stout ligature round the base of its pedicle.

CARCINOMA OF THE NIPPLE

Carcinoma of the nipple is rare. It may be of the squamous-celled or spheroidal-celled type. In the latter case it probably originates in the sebaceous glands of the areola. Early ulceration takes place and the disease then pursues a course similar to that of carcinoma of the mamma itself.



Paget's disease of the nipple. The nipple has been entirely destroyed its place and that of the areola are taken by an intensely red, raw and "weeping surface which extends considerably beyond the original limits of the areola. A carcinoma was present in the breast.

(From [illegible] the Middlesex Hospital.)

PLATE 79

statement that intractable eczema of the nipple is followed clinically by the development of cancer.

Histological appearances.—The description best borne out by my own observations is that originally given by Butlin. The mucous layer of the epidermis is much thickened from hyperplasia and its cells are vacuolated and swollen the corium, the adjacent subcutaneous tissues, and the tissues round the ducts are infiltrated



Fig 948.—Paget's disease of the left nipple. A palpable carcinoma was present in the breast.

(From a case under the author's care at the Middlesex Hospital.)

with small round, lymphocyte-like cells. The galactophorous ducts are dilated and filled with epithelial cells and débris, while smaller ducts and acini may be filled with epithelium or may exhibit epithelial outgrowths into the surrounding tissues. In other cases fully developed carcinoma is seen at some part or other of the breast. The carcinoma may be a duct carcinoma, and Butlin has recorded a case in which squamous celled carcinoma of the nipple was associated with chronic eczema, but the growth is usually acinous or spheroidal-celled, and accordingly the mass which it forms is

of lymphatic obstruction. Recently I have been able to produce definite proof, from the examination of early specimens of Paget's disease, of the correctness of these views. In one case in particular (Fig 249) I detected the fugitive stage of the disease in which complete permeation of the skin lymphatics of the eczematous area is present. These permeated lymphatics subsequently undergo fibrosis with disappearance of the contained cancer cells, and all that is then seen in the dermis is a band of inflammatory round cells lying beneath the disintegrating epidermis

Diagnosis.—If a lump presenting the characters of a carcinoma is already present in the breast, if the axillary glands are hard and

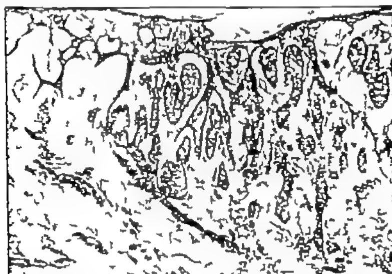


Fig 249.—Section vertical to the skin surface through the edge of the area of Paget's disease. × 74

The anatomical arrangement of the permeated lymphatics is well shown. A group of the blind finger-like ampullæ of origin in the papillæ are seen uniting to form a narrower lymphatic vessel which runs obliquely through the deeper layers of the dermis in the direction of the subareolar plexus.

(*Reproduced from the "Brit. Journ. Surg."*)

enlarged, or if the nipple shows retraction or partial destruction, Paget's disease cannot be mistaken for simple eczema of the nipple. In cases where such signs are wanting, the failure of the usual applications for eczema is the foundation upon which a diagnosis of Paget's disease must rest. *While simple eczema of the nipple may be bilateral,* Paget's disease is a unilateral affection.

Prognosis.—True Paget's disease is, I maintain, invariably associated with carcinoma which usually manifests itself clinically within two years of the onset of the eczema. The prognosis is that of

cancer of the breast in general and is favourable only when early and complete operation is performed. Nevertheless the form of cancer associated with Paget's disease often runs a prolonged course.

Treatment.—If dermatological treatment fails to cure the eczema the case should be treated as one of cancer of the breast even if no lump can be felt (see p 86). In early cases it may not be thought necessary to ablate the pectoral muscles but if this is not done it is extremely difficult to extirpate the highest axillary glands (subclavian glands). If the history of eczema is a long one it is safer to perform the complete operation for carcinoma (p 93)

CHANCRE OF THE NIPPLE

Primary chancre of the nipple is rarely seen in the mother of a syphilitic infant for either she is immunised by a previous attack of the disease, or in accordance with Colles's law the syphilitic fœtus has protected its mother without obviously infecting her. On the other hand, a wet-nurse, or any woman married or unmarried who may casually hold the child to her breast, or who in any other way comes in contact with mucous tubercles of the lips, is liable to contract the disease.

A breast chancre is usually found on the areola at the base of the nipple, but may be situated on the skin of the breast. Though generally single it may be multiple, and both breasts may be affected. It often fails to conform to the type of the characteristic Hunterian chancre. It may present itself as a non indurated and apparently trivial fissure or excoriation, or as a minute rounded and slightly elevated induration, covered by reddened skin, which subsequently ulcerates at its centre. The ulcer gives rise to little discharge and may be covered by a scab. In other cases the base becomes sloughy and phagedæna may supervene. Sometimes the adjoining nipple becomes swollen and painful. Soon the axillary glands become enlarged and hard, but they are not tender nor do they lose their mobility. The further progress of the case is that of syphilis (see Vol. I. p. 780) and the appearance of secondary symptoms clears up any doubt as to the diagnosis if a scraping has not already revealed the presence of the *Spironema pallidum*.

Chancre of the nipple would appear to be decreasing in frequency. Owing to its rarity it is apt to escape recognition.

DISEASES OF THE MAMMARY GLAND

ACUTE MASTITIS

Acute mastitis is usually associated with the function of lactation. This variety, therefore, will first be completely considered, and the rarer ones will be dealt with separately.

The acute mastitis of lactation has for its chief predisposing cause the condition known as milk engorgement, while its exciting cause is the entrance of pyogenetic organisms through a crack or abrasion of the nipple (see Cracked Nipple, p 10) or along the milk-ducts. Acute mastitis may terminate by resolution, or may end in mammary abscess.

Milk engorgement.—During the earliest days of lactation the normal mammary hyperæmia may become excessive. This is especially likely if the milk secreted is unable to escape. Some of the mammary ducts, from long disuse may be partially blocked by epithelial débris, and in this case the signs of engorgement may be restricted to the corresponding lobe or lobes of the breast. Diffuse engorgement of both breasts is usually associated with the sudden cessation of lactation, as upon the death or weaning of the child. Unilateral engorgement commonly depends upon congenital retraction of the corresponding nipple, with consequent inability to suckle on the affected side. The breast becomes swollen, hot, tense, and painful. Irregular branching areas of induration mark out the course of the distended milk-ducts, while the breast tissue itself takes on a coarse granular hardness. The superficial veins are prominent. The axillary glands may become tender and somewhat enlarged. Headache, slight pyrexia, and constipation are frequently present. If a portion only of the breast is affected, the swelling has a sector-shaped outline corresponding to the shape of the affected lobe or lobes. No sharp line of demarcation can be drawn between milk engorgement and acute parenchymatous mastitis terminating in mammary abscess, the one condition passing imperceptibly into the other

It is important not to mistake mere engorgement or parenchymatous mastitis for suppurative inflammation of the breast. No incision should be made into the breast unless the signs of abscess are definite.

The **treatment of milk engorgement** is to empty the breasts, to relieve pain and congestion and to support the heavy breast by a sling or bandage. The first object is best attained by gentle massage directed from the periphery of the breast towards the nipple. Rodman recommends the use of a mixture of lanoline 1 part and benzoated lard 7 parts, as a friction application, the mixture being melted on a water bath each time it is used. Hot fomentations in the intervals of massage relieve pain and congestion, but are likely to increase the risk of suppuration, and in slight cases a cold evaporating lotion is better treatment. A mild purgative is given. If further lactation is not desired, glycerine of belladonna should be applied to the breast and a course of "white mixture" or potassium iodide ordered. Lastly,

and perhaps most important the nipple must be washed with boric lotions, and a mild mercurial ointment should be ordered if there is any crack or abrasion provided that the breast is not being used for suckling The breast must be relieved at intervals by the cautious use of the breast pump

If any crack or abrasion is present upon the nipple of an engorged breast or if bacteria invade the milk-ducts the engorgement passes by imperceptible degrees into a true bacterial inflammation or **acute mastitis.** T H C. Bennans has found that in a large proportion of cases, *Staphylococcus pyogenes aureus* is present in pure culture. In a certain number of cases streptococci and more rarely *Staphylococcus pyogenes albus* are found generally mixed with *S pyogenes aureus* Occasionally in puerperal septicæmia the micro-organisms may gain access to the mammary gland by way of the blood, but mammary abscess is not a common complication of puerperal fever

Cohn and Neumann find that staphylococci sometimes occur in the milk from normal breasts. If there is obstruction to the milk ducts the bacteria rapidly increase in number the imprisoned milk forming an ideal medium for the multiplication of the bacteria which are rarely absent from the region of the nipple According to Bennans the course of events is as follows When suckling ceases, staphylococci multiply in the stagnant milk, and clotting ensues. The irritation caused by the milk-clot, the bacteria and their products, leads to invasion by leucocytes. If these cells are unable to destroy or to render inert the bacteria a mammary abscess results.

The *Staphylococcus pyogenes aureus* is the usual cause of abscesses produced by obstruction to the flow of milk In cases where a streptococcus is found a cracked nipple is usually present, and the infection spreads from the crack along the lymphatics of the breast, without at first causing obstruction to the flow of milk In streptococcal cases accordingly the hard cords felt in staphylococcic infections along the course of the milk-ducts are absent.

Symptoms of acute mastitis.—In acute mastitis the symptoms of milk engorgement are present in a more pronounced degree the breast becomes more tense and prominent, and a local induration becomes evident, most often in the lower part of the gland, while the pyrexia reaches 103 or 104 The induration is frequently sector-shaped, and it spreads rapidly from the nipple towards the periphery of the breast. Throbbing pain and often an erythematous blush are present. Acute localized pain may precede all the other local symptoms. Such cases usually terminate in abscess, and œdema and perhaps fluctuation are soon to be detected over the indurated area, while one or more rigors may occur

Treatment of acute mastitis.—Hot fomentations should be substituted for the cold applications suitable for milk engorgement the infant should be weaned and energetic measures taken to stop the secretion of milk. The breast should be carefully supported by a bandage, but any severe degree of pressure is too painful to be borne. A careful watch must be kept for signs of suppuration.

Acute Mammary Abscess

Though acute mammary abscess is usually connected with lactation this is not invariably the case. Thus, infantile or adolescent mastitis, especially if meddlesome treatment be adopted may not rarely terminate in abscess. At any age an injury of the breast, with or without the formation of a hæmatoma at the seat of injury may lead to an abscess. Occasionally an apparently spontaneous abscess is met with in the adult virgin breast. Of 102 consecutive cases of mammary abscess observed by Bryant 79 occurred during lactation 2 during pregnancy and 21 in patients who were neither lactating nor pregnant

Abscesses of the breast are divided into three classes, according to their situation in the organ—(1) subareolar or supramammary abscess (2) parenchymatous or deep or intramammary abscess (3) retromammary abscess. The first two varieties are common and usually either occur during the first month of lactation, or follow impairment of health by prolonged suckling, or the sudden cessation of lactation Retraction of the nipple which interferes with the due emptying of the breast by suckling favours milk engorgement and abscess The importance of cracks and abrasions upon the nipple has already been mentioned. Retromammary abscess is less closely associated with lactation.

1 In *subareolar abscess* pus forms immediately beneath the skin of the areola Accordingly redness of the skin is an early and prominent symptom, and fluctuation is very obvious. The abscess is smaller and causes less constitutional disturbance, than the deeper varieties of suppuration

2. *Intramammary abscess* is the most common and most important variety Owing to the depth at which the pus forms, fluctuation may be absent, or difficult to elicit Pus may burrow extensively through the gland in various directions before it approaches the skin. Meantime constitutional disturbance is often severe, and the whole breast is involved in œdematous swelling Later when the abscess is beginning to point, the skin becomes red or mottled After such an abscess, unless surgical treatment is careful and thorough, the breast may be left in a disorganized and useless condition riddled by persistent sinuses, and sometimes shrunken and deformed by cicatrization

3 *Retromammary abscess* is not common It may arise from necrosis or tuberculosis of a rib from tuberculosis of the sternum from an infected hæmatoma from suppuration of the deeper portions of the breast or rarely from the escape of an empyema. The collection of pus is usually large and is situated between the great pectoral and the deep surface of the mamma The breast is thrust prominently forward, and is found to be lying upon a fluctuating cushion of pus. The skin of the breast is not reddened The abscess usually points at the lower and outer margin of the breast.

Chronic staphylococcic abscess.—Sometimes, quite apart from lactation and in advanced life, a chronic abscess may form in the breast without apparent reason. No signs of acute inflammation are present. The abscess may be surrounded by a fibrous capsule so thick that fluctuation is absent and the tumour feels solid if at all deeply situated in the breast. The axillary glands may be enlarged and indurated, and only slightly tender Such an abscess closely simulates a malignant growth or tuberculosis of the breast, and exploration by an incision may be necessary to decide the diagnosis. The organism present in these abscesses is usually the staphylococcus, and they are probably due to infection along the ducts. If left alone the abscess may ultimately point and burst, leaving a sinus. The treatment is incision and drainage.

Prophylaxis of acute mammary abscess—It is necessary to take precautions against cracks, fissures, or abrasions of the nipple, to keep the nipple and the child's mouth in as aseptic a condition as possible, and to maintain the patency of the milk-ducts. During pregnancy the nipple should be hardened by regularly rubbing it with alcohol (eau-de-Cologne or spirit) After sucking the nipple must be bathed with boric lotion and then carefully dried and the infant's mouth cleansed with a rag dipped in the same lotion.

Treatment of acute mammary abscess—The abscess if *subareolar* or *intramammary* must be opened at the earliest possible moment by a free incision which in order to avoid cutting the milk ducts should radiate from the nipple. The finger should be introduced into the cavity and all septa found traversing it should be broken down so as to ensure free drainage. A rubber tube should be left in the cavity and careful watch kept for burrowing or pocketing of pus in new directions. A dry gauze dressing, changed daily may be applied.

If any signs of burrowing appear a director must be passed in various directions, and the pockets must either be slit up along their whole length, or opened and drained by tubes at the most dependent points.

Constitutional and general treatment will vary according to the

nature of the abscess. Lactation must be stopped either by the regular administration of white mixture, or of saline purgatives in other combinations, or by giving potassium iodide in doses of 5 10 gr thrice daily At the same time glycerine of belladonna is applied to both breasts, which are then to be firmly bandaged over a layer of wool. If the patient is exhausted by long lactation a more tonic treatment is necessary Saline purgatives must be replaced by iron and strychnine, and a generous diet prescribed, while a glass of burgundy with lunch and dinner may be of advantage after the flow of milk has ceased.

Retromammary abscess is best opened by an incision situated in the sulcus beneath the breast and at its lower and outer margin. Search should be made at the operation for bare bone, and for an opening communicating with the thoracic cavity The deep aspect of the breast should also be explored for any recess or extension of the abscess cavity within the substance of the breast. If found, any such recess must be freely opened up into the general cavity

Mammary abscess due to tuberculous actinomycosis or syphilis will be referred to under the heads of those diseases. Abscess may result from hydatid disease of the breast.

Bier's hyperæmia in acute mastitis.—Bier recommends the treatment of acute mastitis in all its stages by a dome-shaped cupping glass, of a diameter about an inch smaller than the mammary gland itself, and with a margin curved to fit the chest wall. Air is cautiously withdrawn by a suction syringe the breast protrudes into the bell and becomes blue and engorged. When the patient finally feels as if the breast would burst the exhaustion of air should be stopped, for the entire procedure should be painless. Usually one or two ounces of milk escape. Abscesses and sinuses which at first discharge blood and pus, yield only blood-stained serous fluid towards the end of the sitting If pain is not relieved an abscess must be suspected, and should be opened by a small incision, the patency of which must be maintained by a drainage-tube. Large incisions are said to be unnecessary when Bier's treatment is used The glass is to be applied for forty five minutes daily suction for five minutes alternating with release of pressure for three minutes. When suppuration ceases the duration of the daily sitting may be lessened.

Vaccine treatment of acute mastitis.—In acute mastitis where suppuration threatens if a cracked nipple is present, a vaccine may be prepared from the organisms found in the crack, and by its prompt use the formation of an abscess may sometimes be averted. If streptococci are seen in a stained film, a polyvalent antistreptococcic serum may be used without waiting for a cultivation.

In cases of acute mastitis where no cracked nipple is present the *Staphylococcus pyogenes aureus* is probably the infecting agent. It is accordingly reasonable to endeavour to avert suppuration by injections of a stock vaccine of this organism in doses of 100–500 millions at intervals of a week.

If suppuration has already occurred the pus must be let out by incision. The value of vaccine treatment during the acute stage is doubtful.

In cases where sinuses persist usually as the result of inadequate surgical treatment vaccine treatment appears to be of greater value. The treatment should consist in the weekly injection of 400–800 millions of *S aureus* in stock vaccine controlled if the case does not rapidly yield by cultivations which may show the presence of other organisms. In such cases an autogenous vaccine is prepared for use.

CHRONIC MASTITIS

In women who have reached or passed middle life the breasts or portions of them are very liable to undergo certain fibroid changes, associated either with hypertrophy or with atrophy of the secreting epithelium. The condition is known as chronic mastitis or chronic lobular mastitis. According to the condition of the epithelium, two forms may be recognized—hypertrophic mastitis and atrophic mastitis. Chronic mastitis is a frequent precursor of breast cancer (see p 53) and owes its chief importance to this fact and to its clinical resemblances to cancer

Etiology.—Chronic mastitis may occur at any age after puberty It is not very rare in young unmarried women and its frequency probably increases up to a maximum at the menopause the age near which a large majority of the cases occur Some authors state that it is more common among married women but my own experience indicates a greater frequency in the unmarried.

The onset of chronic mastitis is sometimes determined by a blow Lenthal Cheatle has brought forward strong reasons to believe that the pressure of ill fitting corsets and more especially the impaling of the breast upon the upper end of a stay-bone, may induce local mastitis at the seat of pressure.

Chronic mastitis is most frequently seen in the axillary tail and in the portion of the breast immediately adjoining, but may occur in any part of the breast.

It may be regarded as a morbid deviation from the normal physiological processes of evolution and involution which correspond with the sexual crises of a woman's life—puberty menstruation pregnancy lactation, and the menopause. Apart from these physiological tides of tissue-change mild bacterial invasion and obstruction of the ducts

may play a part, though Lenthal Cheatle's researches go to show that the disease is not dependent on bacterial infection.

Naked-eye anatomy of chronic mastitis.—A breast the seat of marked chronic mastitis, when cut across is tough and indiarubbery in consistence, and has not the inelastic hardness of a typical carcinoma. Its colour is whitish or yellowish, with a trace of pink, but without the grey tones usually seen in a carcinoma. Small cysts containing clear or brownish fluid are sometimes a prominent feature. In some cases these cysts attain exceptional development and cause a considerable increase in the size of the breast. To this condition the name "cystic disease of the breast" has been given, but it differs in no essential respect from chronic mastitis (Fig 250)

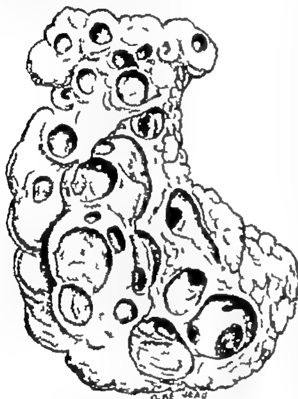


Fig. 250.—Cystic chronic mastitis (cystic disease of the breast)

(From specimen in the Middlesex Hospital Museum.)

Histological changes.—In the hypertrophic form of chronic mastitis the lobules are much increased in size by proliferation of their constituent acini (Fig 251) Though this is the most important change it is not the earliest. The epithelial hypertrophy is preceded by changes *in the lobular and* peri-acinous connective tissue The lobular connective tissue is swollen and increased in amount, and the connective-tissue sheath of each *acinus becomes* thickened and unduly cellular and is the seat of a round-celled infiltration of varying degree. The elastic tissue around the ducts tends to disappear Later the richly cellular peri acinous connective tissue changes into characteristic rings of homogeneous fibrous tissue almost free from nuclei. The interlobular tissue also undergoes a fibroid change and much of the fat disappears.

Atrophic chronic mastitis (fibroid breast) appears to be a late stage of the hypertrophic variety. In this form a microscopic section shows dense and old fibrous tissue poor in nuclei. Embedded here and there in the fibrous tissue, islets of fat cells still remain. The lobules (groups of acini) which have escaped destruction are small, few in number and widely scattered. The epithelium of the acini is far advanced in degeneration and may be represented by a few shrunken cells, often with loss of the central lumen or merely by a little mass of débris (Figs. 252, 253).



Fig 251.—Hypertrophic mastitis. Note the increase in size of the lobules. At the lower margin of the figure the edge of an infiltrating carcinoma can be seen—a condition into which hypertrophic mastitis may readily pass.

Symptoms.—Many women present some degree of chronic mastitis without any corresponding symptoms. In other cases, however, pain is a prominent symptom—usually a dull ache, but occasionally very severe, lancinating or neuralgic in character and very intractable. The pain may be worse and the swelling more marked during the menstrual periods. It is often aggravated by movements, and especially by the prolonged use of the arm or by jolting movements such as descending stairs.



Fig. 252.—Microscopic appearances of atrophic mastitis. Note the atrophy of the lobules, the increase of fibrous tissue, and the disappearance of the interlobular fat.

Discharge from the nipple.—The frequent presence of tense cysts in chronic mastitis shows that there is considerable secre-

tory pressure within the gland. It is, therefore, not surprising that a serous discharge from the nipple appears in certain cases in which obstruction of the ducts is incomplete. The discharge may sometimes be made to flow by pressure upon the affected portion of the gland. It emanates from the particular orifice upon the nipple which corresponds to the diseased lobe of the gland. Such cases are often very difficult to distinguish from early examples of duct papilloma. Fortunately the doubt in diagnosis makes no difference as regards treatment, for it is a rule to which, in my opinion, there are no exceptions, that persistent serous discharge from the nipple in a woman of middle age should be the signal for excision of the breast.



Fig. 253.—Advanced atrophic mastitis or fibroid breast. The lobular epithelium has almost disappeared, but a few dark rings indicate remains of epithelium. On the right is seen fat undergoing fibroid change.

Physical signs.—There is a granular induration of the whole or part of the breast tissue only vaguely felt when the breast is compressed between the flat hand and the pectoral muscle, but assuming the characters of a definite tumour when the breast is compressed laterally between the thumb and fingers. When cystic changes are present the cysts usually feel solid, and the breast feels more coarsely granular. Although it is often stated that retraction of the nipple and adhesion of the skin may occur in chronic mastitis, the presence of these signs should give rise to the gravest suspicion of malignant disease. Nor is adhesion of the breast to the pectoral fascia ever seen in chronic mastitis.

Atrophic chronic mastitis involving the whole breast may reduce the gland to a firm, "rubbery" highly convex disc with thick rounded edges, resembling in shape the end of a lemon, and not exceeding 2 in. in diameter. This condition is only found as the menopause is approached. It is due to fibrous change retracting all the lobes towards the nipple, their common point of attachment. It must be remembered that an abscess may leave a palpable fibrous area in the breast, adherent to the skin at the point where the abscess burst.

Sector shaped indurations.—In many cases the area of induration is sector-shaped. In doubtful cases I have come to rely more upon this sector-shaped induration in the diagnosis of chronic mastitis than upon any other point. The breast as we have seen is made up of a number of sector-shaped lobes which are practically independent organs, each opening upon the summit of the nipple by the separate orifice of its own proper duct. Very frequently chronic mastitis affects one of the lobes alone or several adjoining ones while the rest of the breast remains normal and unaffected.

It will be observed that these facts supply a most important means of distinction between chronic mastitis and malignant disease. It is a characteristic feature of carcinoma that it has little or no respect for anatomical boundaries. If a carcinoma starts at one point in the breast it will not remain confined strictly to the lobe in which it originated, but will infiltrate the surrounding tissues in a more or less centrifugal manner producing a rounded lump which has no relation to the anatomical shape of the particular lobe in which the growth originated.

Sometimes the breast contains two or more non-contiguous sector shaped areas of induration, while in other cases, of course, the whole breast presents an indefinite induration.

It must however be remembered in respect to this important physical sign that it does not exclude the possibility that an early carcinoma is present within the sector-shaped area. If, however the area of induration is uniformly and finely granular without any localized lump or induration this unpleasant possibility may be excluded almost with certainty.

Chronic mastitis and fibro-adenoma.—Areas of chronic mastitis are not infrequently met with in the immediate neighbourhood of a fibro-adenoma giving to the smooth surface of the tumour a rough, granular feeling. The pathology of such areas is not difficult to fathom if it be borne in mind that a fibro-adenoma often arises in connexion with, and necessarily obstructs, one of the ducts of the breast. The acini which open into this particular duct having no outlet, undergo the usual changes of chronic mastitis. It is often exceedingly difficult to differentiate a fibro-adenoma thus obscured by surrounding chronic mastitis from a carcinoma. I have most frequently met with such fibro-adenomas in or near the axillary tail of the breast.

F T Paul has, moreover shown that a fibro-adenoma may originate in an area of pre-existing chronic mastitis by the overgrowth of the connective tissue of one particular lobule of the affected area. Thus fibro-adenoma may be either a cause or a consequence of chronic mastitis.

Chronic mastitis in duct papilloma.—In another condition chronic mastitis may arise from obstruction of the ducts, namely duct papilloma. When a duct papilloma obstructs one of the large ducts near the nipple the corresponding lobe is often mapped out as a vague sector-shaped induration. Pressure upon the indurated area often causes serous fluid to exude, or even squirt, from the affected duct, while pressure upon the normal portions of the breast has no effect.

Enlargement of the axillary glands.—It is not uncommon to find in chronic mastitis that the axillary glands are unduly palpable—that is to say they are slightly but not much enlarged The glands are firm and elastic, and sometimes tender The slight degree of enlargement, the tenderness, and the absence of hardness help to distinguish *them from secondary carcinomatous glands*

Bonney has drawn attention to the precarcinomatous changes which occur in lymphatic glands. When a cancer is present, e g. in the breast, the axillary glands become enlarged owing to the appearance of large and active germinal areas, to an increase in the number of lymphocytes, and to the appearance in the gland of large quantities of plasma cells. All these changes, according to Bonney occur before any malignant cells have reached the gland. In a less degree he found the same changes in the axillary glands of ten breasts removed for chronic mastitis and proved microscopically to be free from cancer

A consideration of these facts makes it seem likely that cases of chronic mastitis in which the glands are unduly palpable are more likely to end in cancer than are those in which this sign is absent. In such cases removal of the breast may be the best course to pursue, but no general rule can be laid down.

Diagnosis.—The indurations of chronic mastitis are characterised by their vague definition when palpated by the flat hand thus differing from both simple and malignant tumours. The sector shape of the indurations is also characteristic when only part of the breast is involved Moreover as further *distinctions* from carcinoma, nipple retraction and adhesion to skin and fascia are absent. A *carcinomatous lump in the breast is usually single, while* the indurations of chronic mastitis are often multiple. The axillary glands are softish, elastic possibly tender and not much enlarged while the glands in carcinoma are hard painless, and often much increased in size If a hardness is present in the area of ill-defined induration, it may be impossible to say without operation whether a carcinoma or a simple cyst is the cause (Fig 254) for it must not be forgotten that a carcinoma may arise in a pre-existing area of mastitis.

Prognosis.—In young women chronic mastitis is tractable and not dangerous but as the menopause is approached, a more

guarded prognosis and a closer watch become necessary in view of the intimate relations between chronic mastitis and cancer

Treatment.—In some cases of chronic mastitis especially in young women the usual medical treatment is satisfactory The means employed comprise (a) pressure applied by means of strapping, or less effectively by bandages (massage is not advisable) (b) inhibition of the secretory activity of the epithelium by belladonna and iodides (c) the administration of drugs which promote the absorption of inflammatory infiltrations especially mercury and the iodides. The old fashioned emp. hydrarg c ammoniaco renewed weekly is a valuable application but is liable to cause eczematous irritation of the skin This risk can be minimized by antiseptic cleansing of the skin before the plaster is applied Another method of using mercury is to apply Scott's ointment diluted if necessary and to secure pressure at the same time by means of strapping. Iodides may be applied locally in the form of the lin. pot. iod c. sapone a very clean and pleasant preparation but not in my belief a very effective one Belladonna may be used as the glycerinum or unguentum, combined, if necessary with a mercurial ointment It is especially valuable where pain is a prominent symptom.

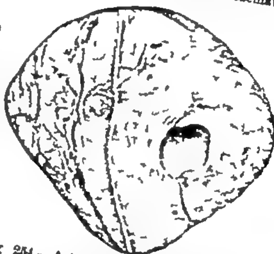


Fig 254.—A breast, the seat of chronic mastitis and containing a single cyst. The case simulated a carcinoma, and the breast was therefore removed.
(From St. Thomas' Hospital Museum.)

But in numerous instances more especially in climacteric mastitis drug treatment seems to have no effect In such cases removal of the breast is often justifiable. F T Paul says — I am no advocate for the removal of the breast for mastitis in young women but as regards the involution period I strongly maintain that amputation is indicated in all cases of unyielding or very marked and especially bilateral, chronic mastitis"

There can be no doubt that such a course is the safest But removal of the breast, although not in itself a severe or dangerous operation, is a measure to which few women will consent unless the

isk of cancer is immediate and great. Moreover there are numerous clear *cases of chronic mastitis in which cancer* can be definitely excluded, even in women who have reached the cancer age. In such cases I do not advise operation.

Thus, deducting the cases where drug treatment is successful and those threatening or doubtful ones where operation is clearly indicated, there remains a considerable residue of cases for which hitherto no very hopeful treatment has been available.

In such cases, during the past few years I have recommended a short course of X rays as a sedative to epithelial activity and a prophylactic against cancer.

With regard to the clinically appreciable effects of X rays in chronic mastitis, my experience is at present recent and restricted but on more than one occasion after their use I have seen indurations of the breast clear up or become almost inappreciable. Sometimes on the other hand, the induration remains unaltered, and in two cases carcinoma has shown itself in cases under treatment. Accordingly it cannot be said that the X ray methods of the recent past afforded any security against the evolution of chronic mastitis into carcinoma. *In refractory cases X ray treatment should not be continued*, and removal of the breast should be considered.

Further experience has confirmed my belief in the value of X rays in chronic mastitis.

CHRONIC DUCT CATARRH OF THE BREAST

Closely related to chronic mastitis and yet often clinically distinguishable from it, is a condition which I will call chronic duct catarrh. It has not yet received full recognition. Lenthal Cheatle has done much to elucidate it on the pathological side. It consists in a diffuse benign desquamative hyperplasia of the epithelium of the ducts of some or all of the lobes of the breast. The ducts are choked with shed necrotic epithelium, and around them are fibrous hyperplasia and often abundant patchy round-celled infiltration. These conditions may lead to cystic distension of the affected ducts (chronic cystic *mastitis*) or *to the appearance within the affected ducts of papillomatous* ingrowths of epithelium which are liable later on to become the starting-points of carcinoma. If large cysts are formed, cancer is not so likely to arise, because their lining epithelium then undergoes atrophy.

Clinical signs.—Chronic duct catarrh is not generally seen before middle age. It presents sector-shaped induration of the affected lobe or lobes just like that seen in chronic mastitis. It may give rise to serous or blood-stained discharge from the nipple. The orifices of the milk-ducts may present a white-spot appearance like that of a blocked sebaceous gland, and sometimes plugs of epithelial *débris* can

be expressed from them Radiating from the nipple one or more of the main ducts may be felt as hard subcutaneous cords running towards the indurated areas of the breast In the innocent stage of the disease signs of contraction and adhesion are absent

Treatment.—If the presence of chronic duct catarrh can be definitely recognized removal of the breast should be advised as the only treatment which offers security against the later advent of cancer

TUBERCULOUS MASTITIS

Tuberculosis of the breast is rare accounting for only about 1 per cent of hospital admissions for mammary disease More than half the cases occur between the ages of 25 and 35 and very few indeed after the menopause though even old age is not exempt. The affection is usually unilateral. It may form the only discoverable tuberculous focus present in the body but in 50 per cent of cases it is secondary to tuberculous elsewhere as for instance in the supraclavicular or axillary glands, or in the lungs. Infection probably occurs as a rule through the blood-stream or by direct extension from the adjoining ribs or pleura But it is not rare for tuberculosis of the cervical glands to extend downwards to the axillary glands and a continuance of the same process of retrograde infection along the lymphatics to the breast may be responsible for some cases of mammary tubercl It is also possible that direct infection along the ducts from the nipple may in some cases take place In one recorded case the disease began as an ulceration of the nipple

Morbid anatomy.—Miliary tubercles may be scattered through the breasts in cases of general tuberculosis, but this form of the disease possesses no separate importance. In tuberculous mastitis the breast in section presents multiple caseating foci separated by fibrotic areas, and areas of healthy tissue Later these caseating areas tend to coalesce and break down and one or more abscesses lined by pale and flabby granulations and containing caseous pus, may be formed. These abscesses, after breaking through the skin shrink into chronic sinuses, and in the latest stage the breast becomes a fibrous relic riddled in all directions by tuberculous sinuses.

Microscopic anatomy.—In its earliest stage tuberculosis of the breast presents itself microscopically in the form of dense masses of lymphocyte-like cells around the acini and along the course of the smaller ducts The collection of round cells lies outside the layer of fibrous tissue which immediately surrounds the epithelium. Giant-cell systems may be absent (Fig 205.) As the areas of round cells increase in density the epithelial structures quietly atrophy and disappear leaving a mass of tuberculous granulation

glands are usually unaffected. Later at various points over the indurated area, softening may be detected. The skin at these points becomes reddened, glazed and thinned, and finally gives way. A number of discharging sinuses are left, burrowing in various directions through the shrunken breast, and exuding pus containing the characteristic and diagnostic "iodoform granules." The disease may spread by metastasis to other regions of the body.

Treatment.—In the early stage the free administration of potassium iodide in large doses is indicated. Later if the disease is primary complete excision of the affected breast is probably the best treatment. If the disease is well localised the affected part may be resected.

GUMMA OF THE BREAST

In the tertiary stage of syphilis, localised deposits of syphilitic granulation tissue may occur in the breast as in most other parts of the body. Gummata of the breast are however not common. They may be single or multiple, and are rarely found except in association with active manifestations of the disease in other regions—a fact which is of great assistance in diagnosis. A gumma presents itself as a firm and even hard tumour fixed in the breast, painless, palpable with the flat hand, and sharply defined from the surrounding tissues. It soon becomes adherent to the skin and to the underlying pectoral fascia. The adherent skin may present the *peau d'orange* appearance. Retraction of the nipple may be present if the tumour is subareolar. Up to this stage the diagnosis from carcinoma depends chiefly upon the history and upon the presence of other syphilitic lesions. Soon, however the adherent skin over the tumour becomes thinned and congested, and a central area of softening appears in the hard tumour. The skin now gives way and a puriform discharge escapes. The ulcer thus formed may present the characters of a typical gummatous ulcer with a sloughy base. Occasionally a massive slough is thrown off and the ulcer spontaneously heals. The glands in the axilla do not as a rule, become enlarged unless secondary infection occurs through the ulcer. Treatment is an important means of confirming a provisional diagnosis of gumma. In rare cases, diffuse unilateral induration of the breast has been observed comparatively early in the secondary stage of syphilis.

Treatment.—The regular and vigorous administration of potassium iodide, beginning with 5 or 10 gr thrice daily and increasing the dose to 20 or even 30 gr will usually bring about rapid and complete disappearance of the induration. If the gumma is ulcerated a mild mercurial ointment should be applied. In obstinate cases a course of salvarsan injections should be given.

HÆMATOMA OF THE BREAST

This condition is not often seen, and is usually due to a blow. The rapid appearance of a traumatic swelling, associated after a day or two with cutaneous ecchymosis and its disappearance within two or three weeks, are characteristic points. The swelling may correspond in outline to the sector shape of a single mammary lobe or of several adjacent lobes. Hæmatoma may follow an operation for the removal of a simple tumour unless the cavity left is carefully obliterated.

Treatment.—The breast should be strapped, or at least supported in a sling, and manipulation must be avoided. In view of the fact that trauma is a possible cause of malignant disease, a short prophylactic course of X rays may be advisable. If a swelling remains after the lapse of some weeks an exploratory incision must be made.

ELEPHANTIASIS

In tropical countries in one case in 690 of elephantiasis, the disease affects the breast. The breast becomes enormously and uniformly enlarged, and the skin over it thick, leathery and pitted by enlarged gland orifices. The nipple may hang as low as the umbilicus, and may even reach the pubes.

These changes are preceded by attacks of acute lymphangitis, which lead to obliteration of many of the lymphatics of the breast. The enlargement of the organ and the thickening of the skin over it are results of lymphatic obstruction. The cutaneous appearances are exactly those of the pigskin familiar in cases of carcinoma.

Diagnosis.—In tropical countries confusion may arise between elephantiasis and malignant disease of the breast. But in elephantiasis the breast is very greatly enlarged and no lump is present in it.

Treatment.—In early stages the breast must be supported by a sling. In view of recent work by Dufougeré, Foulerton, and myself, which tends to prove that elephantiasis depends upon a chronic infection by the *Staphylococcus pyogenes albus*, a vaccine of this organism should be tried to arrest the disease in its earlier stages. But in late cases amputation of the breast is indicated. It is unnecessary to remove the pectoral muscles or to clear out the axilla.

CYSTS OF THE BREAST

Cysts of the breast may be divided clinically into two main classes—(1) those arising in connexion with solid neoplasms (neoplastic cysts) and (2) those of obstructive or inflammatory origin where no new growth is present (simple cysts). It is difficult to be sure that a cyst, apparently simple, is not really neoplastic. When a cyst has been assigned to the neoplastic category the vital question still

remains whether the solid tumour connected with it is innocent or malignant

Cysts of the breast usually occur after the age of 40 They are not very common, forming less than 3 per cent. of cases of mammary tumour which come under hospital treatment.

The many varieties of cysts that occur in the breast may be classified as follows —

1 Cysts arising from distension of the larger ducts. These cysts are usually single and situated near the nipple
 i. Galactocele, or milk-cyst.
 ii. Simple subareolar cyst.
2. Multiple cysts arising from distension of the smaller ducts. These cysts are the result of chronic mastitis or of chronic duct catarrh. The condition known as general cystic disease of the breast is simply an exaggerated form of cystic chronic mastitis (Fig 250 p 22)
3. Cysts due to the distension of lymphatic spaces.
4. Cysts arising in connexion with simple tumours.
 i. Cystic fibro-adenoma.
 ii. Cystic duct papilloma (Fig. 262, p 49)
5 Cysts arising in connexion with malignant tumours.
 i Carcinoma with cystic degeneration or arising in the wall of a pre-existing cyst.
 ii Cystic forms of sarcoma.
6 Parasitic cysts due to the echinococcus.

In this section galactoceles, simple subareolar cysts, and hydatid cysts will be considered cysts of neoplastic origin will be dealt with in the section relating to the tumours with which they are associated

Galactocele

A galactocele is a rare mammary cyst containing milk in a more or less inspissated and altered condition. Arising from the obstruction of one of the large ducts or milk sinuses, these cysts are formed during lactation, though they may persist after it has ceased. In rare cases, galactoceles are said to occur in women who have never been pregnant, but some of these are probably tuberculous abscesses. The nature of the causative obstruction is not certainly known. Some authors maintain that it arises from excessive proliferation of the duct epithelium and blows, injuries, and surgical incisions near the nipple have been claimed as etiological factors

Galactoceles are situated beneath or near the areola and are, as a rule, single, though I have seen two in the same breast. They are of moderate size, rarely exceeding 3 in. in diameter but one enormous example, recorded by Scarpa. after two months growth contained

10 pints of milk. The wall of the cyst, which in old examples may be of some thickness, is composed of fibrous tissue and lined by the stretched and atrophied epithelium of the duct. The contents may resemble colostrum, or normal inspissated milk or may be a butter-like material

Symptoms and signs.—Close to the areola there is present a rounded painless, fluctuating swelling which on pressure exudes a milky fluid through the nipple. It usually appears during the early weeks of lactation and may increase in size during the act of suckling (Astley Cooper) In longstanding cases its contents become inspissated and its consistence doughy

Diagnosis.—The commencement during lactation and the exudation of milk from the nipple if the cyst is pressed, usually render diagnosis easy A galactocele may however be mistaken for a chronic tuberculous abscess, for a simple subareolar cyst or for a cyst connected with duct papilloma.

Treatment.—Unduly active treatment is to be deprecated. If the cyst reaches any size the child should be weaned, the cyst aspirated, and pressure applied to the breast by strapping If these measures fail, the cyst is to be incised radially from the nipple, and either completely removed, or packed and allowed to heal from the bottom

Simple Subareolar Cyst

Simple subareolar cyst is due to the obstruction of one of the large ducts near the nipple. These cysts are usually single, contain clear serous fluid, and seldom exceed 1 to 1½ in. in diameter They are frequently associated with a vague induration of the corresponding lobe of the breast. Fluctuation is usually evident Pain, tenderness, and enlargement of the axillary glands are generally absent. A discharge from the nipple is occasionally present but if marked and especially if blood-stained, it should arouse suspicion that the cyst is associated with duct papilloma.

Cysts exactly resembling the subareolar cyst may arise from the distension of ducts in the deeper parts of the breast they are usually associated with chronic mastitis or with chronic duct catarrh.

Treatment.—Any suspicion of malignancy must lead to an immediate exploratory operation (*see* p 92) If the cyst is certainly innocent, milder measures may be tried. The cyst may be aspirated and the breast subsequently strapped. A more effective method is to tap the cyst with a hypodermic needle, and to inject 5 to 10 minims of 1 per-cent. solution of protargol, or the same quantity of pure phenol. The breast is subsequently manipulated to ensure that the fluid comes in contact with the whole interior of the cyst. If these

measures fail, the cyst must be excised through an incision radiating from the nipple so as not to divide any of the ducts. In certain cases, Gaillard Thomas's operation (see p. 42) may be employed.

Hydatid Disease of the Breast

This condition is of great rarity. A small, painless, hard lump forms in the breast, and is discovered by accident. When it reaches the size of an egg, fluctuation can usually be detected in it. Further slow increase in size during a period of years produces a prominent globular tumour as large as an orange, moving with the breast, still painless, and not adherent either to skin or fascia. The nipple is not retracted, nor are the axillary glands enlarged. If nothing is done, suppuration may ultimately occur, probably as a result of the death of the hydatid. Pain is felt in the swelling, the skin becomes reddened and the tumour itself is larger and more prominent. The integument becomes thinned at one or several points, and sinuses form through which thin pus is discharged, containing daughter cysts and hydatid membrane. In this way the whole of the hydatid may be discharged and a spontaneous cure may result.

Diagnosis.—The presence of a globular painless, fluctuating single tumour of slow growth, of considerable size, and presenting the other characters already referred to raises a presumption of hydatid. A hydatid cyst does not give rise to discharge from the nipple—a point of distinction from cystic duct papilloma. A simple cyst rarely attains a size beyond that of an egg. The diagnosis can only be made conclusive by an exploratory puncture. If the fluid withdrawn is free from albumin, and more especially if it contains booklets, the diagnosis of hydatid is established.

Treatment.—The disease is practically free from risk to life. An incision radiating from the nipple is made down upon the cyst, which is enucleated entire. The cavity may be obliterated by suturing its walls together and the skin sewn up. Of course if suppuration is present, no attempt to secure primary union must be made.

Diagnosis of mammary cysts.—Cysts of the breast are often very tense, and consequently fluctuation is frequently absent, and diagnosis from a solid tumour may be impossible, especially if the cyst is deeply situated, without the aid of an exploring needle. The use of this instrument is free from objection, and is painless if a little ethyl chloride be used to freeze the skin. Microscopical examination decides whether the fluid is milky as in galactocele, serous as in duct papilloma, purulent as in tuberculous abscess or acute mammary abscess, containing hooklets as in hydatid cyst, or bloody as in malignant growth and in duct papilloma. Usually the microscopical examina-

tion is practically negative. If albumin is present in the fluid, non suppurating hydatid cyst is of course excluded and the diagnosis probably lies between two common types of cyst—the simple cyst associated with chronic mastitis, and the papilloma bearing cyst. In the latter case there is usually a history of serous discharge from the nipple, often blood-stained.

This brief summary fails to take account of the cysts associated with malignant tumours, which, though rare, are of great importance. The question, "Is a malignant neoplasm also present?" arises in every case of cyst. The size of the cyst is of great significance in settling this question. Simple cysts of the breast rarely exceed 1 to 2 in. in diameter They are usually situated near the nipple, and do not rapidly increase in size If the cyst is large and rapidly developed a grave suspicion of malignant disease or of duct papilloma must be entertained, even though after aspiration no induration remains in the breast. I have a vivid recollection of removing by aspiration 15 oz. of fluid from a cyst, leaving the breast apparently quite soft and normal. Within six months the patient was dead from a most acute carcinoma which developed so rapidly that operation was evidently useless. The rare cases of rapidly growing cystic adenoma are not numerous enough to impair the validity of the rule. Moreover in view of the affinity of this tumour with sarcoma excision of the breast is the best treatment. For a large cyst of the breast, removal of the whole organ is the only procedure which gives any thing like absolute security

When a cyst is excised a microscopical examination of the cyst wall must on no account be omitted even when the characters of the excised cyst appear to be innocent.

TUMOURS OF THE BREAST

On its clinical side the subject of tumours of the breast is complex and difficult, while pathologically it is relatively simple though its literature is puzzling owing to a redundant nomenclature.

The following list appears to contain all tumours primary in the breast. It might be lengthened by adding tumours of extraneous *origin* such as secondary melanotic sarcoma or angioma of the skin invading the breast, or by wrongly assuming that secondary accidents and degenerations, such as colloid change in *carcinoma* or cystic changes in fibro-adenoma, are fundamental characters.

A. Innocent Tumours.

(a) Of *epithelial* origin wholly or mainly

1 Duct papilloma.

2 Pure adenoma.

(*b*) Of *connective-tissue* origin, wholly or mainly

1. Fibro-adenoma.
2. Soft fibro-adenoma.
3. Fibroma (probably a fibro-adenoma from which epithelium has disappeared)
4. Lipoma.
5. Myxoma.

B. MALIGNANT TUMOURS.

(*a*) Of *epithelial* origin.

Carcinoma.

i. Spheroidal-celled, originating in the acini.
ii. Columnar-celled, originating in the ducts.

(*b*) Of *connective-tissue* origin.

Sarcoma, round-, spindle- or mixed-celled, or containing cartilage (chondro-sarcoma) or bone.

Ernest Shaw has well summarized the relations of the mammary epithelium to tumour-formation. He points out that the epithelium in a duct or acinus may grow (*a*) outwards, away from the lumen, or (*b*) inwards into the lumen. In the former case the cells may in their growth either (*a*) imitate the normal gland tissue, forming new acini and ducts, accompanied by supporting connective tissue (adenoma) or (*b*) grow out in a disorderly manner sometimes preserving for a time their tubular arrangement (adeno-carcinoma) but later penetrating the basement membrane and then infiltrating other tissues (carcinoma and duct carcinoma). If the cells grow into the lumen of a duct they may similarly (*a*) form a regularly organized simple papilloma (duct papilloma) or (*b*) form an irregular mass of cells which ultimately breaks through the wall of the duct and infiltrates the tissues beyond (duct carcinoma).

FIBRO-ADENOMA[1]

This simple tumour consists of an encapsuled mass of fibrous tissue containing tubes or spaces lined by epithelium. A large majority of the simple tumours of the breast are fibro-adenomas. When the term fibro-adenoma is used alone, the ordinary or hard fibro-adenoma is meant. This will be first described, and afterwards the rare soft variety will be considered. Fibro-adenomas may be single or multiple, and may present themselves in one breast or in both. They are very rare in the male breast. The smallest examples are of microscopic dimensions, while the largest may be 3 in. or more in diameter, enlarging the breast and forming a considerable part of its bulk. Usually they do not exceed the size of a hen's egg. They most commonly

[1] *See also* Vol. I., pp. 463 *et seq.*

affect the neighbourhood of the nipple and the axillary tail of the breast Their outline is sometimes obscured by a surrounding area of coarse granular induration due to local chronic mastitis probably caused by obstruction of some of the ducts by the tumour

Etiology—Nothing certain is known with regard to the causation of these tumours. Among 100 cases of fibro-adenoma observed by Bryant 27 were first discovered between puberty and the age of 20 35 between 20 and 30 22 between 30 and 40 13 between 45 and 50 and 3 after 50 Forty-six of the patients were unmarried 37 fruitfully married, and 16 married but sterile. In reference to these figures, it must be noted that a small tumour in the breast may remain undiscovered for years, and it is probable that nearly all fibro-adenomas arise between puberty and 30 years of age they do not occur before puberty They sometimes respond by increased growth, after remaining stationary for years, to the stimulus of pregnancy In a case of Erichsen's a fibro-adenoma the size of a walnut after persisting unchanged for eighteen years, assumed the characters of a soft fibro-adenoma, and rapidly grew until in six months it weighed 6 lb Such cases suggest the origin of sarcoma from fibro-adenoma a question which will be again referred to



Fig 250.—A typical fibro-adenoma after enucleation.

Morbid anatomy.—Fibro-adenomas are always surrounded by a very definite capsule of fibrous tissue which is but loosely adherent to the tumour within In shape the smaller examples are spheroid or ovoid, while the larger ones are more or less lobulated (Fig. 256) On section the capsule is seen as a layer clearly defined from the whitish or pinkish white substance of the tumour Knobbed and foliated fibrous masses may protrude from the cut surface, or the tumour may be homogeneous, presenting a smooth section marked by whorls and bands of fibrous tissue in which here and there a few small stellate chinks are just visible to the naked eye

Microscopical anatomy—Fibro-adenomas arise from local hypertrophy of the transparent fibrous tissue surrounding the epithelial tubes of the breast called by Warren the periductal tissue, which develops at puberty The epithelium in many cases of fibro-

adenoma appears to play a purely passive rôle, but sometimes the acini exhibit considerable proliferative activity The microscopical varieties of fibro-adenoma are not clinically distinguishable.

Origin and development of fibro-adenomas.—In the common form of fibro-adenoma, called by American authors *intracanalicular* the growing fibrous tissue around a duct becomes convoluted and infolded into the interior of the duct in the form of blunt rounded processes, each of which is covered by atrophic epithelium representing the stretched epithelium of the duct. Secondary knobs and convolutions develop upon the ingrowing processes. The whole interior of the rounded tumour within its fibrous capsule, is packed with these blunt polygonal processes If in this stage the



Fig 257 (schematic)—Three stages in the history of the common intracanalicular fibro-adenoma. A, Ingrowth of the fibrous convolutions into the duct. B Their full development. C, Consolidation of the tumour by fusion of the apposed processes. The chink like spaces so prominent in B have almost disappeared.

tumour is cut into the closely packed lobulated masses come apart and protrude through the incision (Fig 257 B) If an empty paper bag, squeezed together by the hands into a tight ball, be cut through with a knife, the appearance of a fibro-adenoma in section is closely simulated. Such a paper ball is structurally comparable to a fibro-adenoma

A microscopical section at this stage shows masses of fibrous tissue of polygonal outline separated by narrow epithelial-lined chinks. The process resembles superficially what is seen in duct papilloma but is really entirely different In a fibro-adenoma the actively growing element is fibrous tissue and the epithelium plays a merely passive rôle. In duct papilloma, on the contrary the ingrowing

papillæ present well-developed and actively growing epithelium, and the fibrous core of the papilla serves merely to nourish the active epithelium. A lack of appreciation of this distinction has led to endless confusion in works upon diseases of the breast. Discharge from the nipple—characteristic evidence of secretory activity of the epithelium in duct papilloma—does not occur in fibro-adenoma. The mutual pressure of the closely packed fibrous ingrowths in a fibro adenoma ultimately leads to the atrophy and destruction of the thinned epithelium which covers them The narrow intervening chinks now become bridged by newly organized fibrous tissue and the lobulated processes are consolidated into a solid fibrous tumour in which here and there stellate spaces lined by unobliterated epithelium remain. In this stage a transverse section appears to the naked eye solid and homogeneous (Fig. 257 c)

In an old fibro-adenoma all traces of epithelium may become obliterated and the tumour is then classified as a fibroma. A rarer variety of hard fibro-adenoma called by American authors the *pericanalicular* fibro-adenoma, which is clinically indistinguishable from the common variety presents active overgrowth of the fibrous tissue surrounding the acini and small ducts of one or more lobules of the breast, but without bulging of fibrous prominences into the interior of the affected epithelial channels. The ducts and acini remain undistorted, while the fibrous layer surrounding them undergoes a concentric hypertrophy Instead of irregular flattened chink like spaces lined by epithelium, this variety presents practically normal epithelial tubes surrounded by masses of fibrous tissue arranged concentrically to the epithelial tubes. There is, however no essential difference between the two forms of fibro-adenoma just described for the same tumour may at different points present the characters of both.

Symptoms and signs.—A fibro-adenoma of the ordinary or hard variety presents itself as a firm, elastic rounded lump not usually larger than an egg, palpable with the flat hand and freely movable in the breast tissues. There is no adhesion to skin or fascia nor enlargement of the axillary glands. Retraction of the nipple never occurs. The smaller examples are more or less spherical in shape in the larger ones lobulation becomes evident As a fibro-adenoma enlarges the subcutaneous tissues over it seem to undergo atrophy from stretching, and the tumour becomes superficial lying close beneath the skin across which enlarged veins may often be seen coursing. The skin glides freely over the tumour on stretching it the lobulation of the tumour may become visually obvious.

As a rule, fibro-adenomas do not cause pain except in neurotic persons, or in those who are obsessed by the fear of cancer Not

infrequently however they become tender during menstruation, In exceptional cases, severe neuralgic pain in the breast may depend upon the presence of a small fibro-adenoma.

Differential diagnosis.—A *tense cyst* in which fluctuation cannot be obtained closely simulates a fibro-adenoma The diagnosis is especially difficult if the swelling is deep in the breast Though exploratory puncture will often settle the diagnosis, it is not imperative, since in either case an operation is usually necessary

Considerable difficulty may arise when the fibro-adenoma is embedded in an area of indurated chronic mastitis. The rounded contours of the tumour are obscured, and its mobility sometimes seems to be impaired. In such circumstances it may closely simulate a *carcinoma* and an exploratory incision may be the only means of settling the diagnosis.

The simulation of fibro-adenoma by certain forms of carcinoma is dealt with at p 86. Here it need only be said that a tumour of the breast presenting the characters of a fibro-adenoma, should be regarded with grave suspicion if it first appears after the age of 40 An early *sarcoma* can only be distinguished by the rapidity of its growth as compared with a fibro-adenoma.

Treatment.—Fibro-adenomas in young women under 30 if small and not increasing, may be lot alone if the patient can be kept under observation But in view of the mental uneasiness caused by any lump in the breast, and of the possibility of malignant change, excision is the best treatment, and is imperative if the patient is approaching middle age. The tumour grasped firmly in the left hand, is boldly cut down upon so as to incise its capsule by an incision radiating from the nipple. It can then easily be enucleated from its surroundings. The cavity left is washed out with 1 1 000 perchloride of mercury solution to destroy any mammary epithelium set free, and is obliterated by buried sutures approximating its sides Unless this is done a hæmatoma is likely to appear

Gaillard Thomas s method.—This is a convenient opportunity to describe the operation of Gaillard Thomas—a method of removing simple tumours of the breast which avoids a subsequent visible scar The operation depends upon the fact that the important arteries of the breast enter at the upper margin, while its posterior surface has but few vascular connexions with the retromammary tissues. The incision follows the sulcus between the breast and the chest wall, along the outer and the lower margin of the breast. The edge of the breast being exposed, the gland is stripped upwards from the great pectoral and is at the same time rotated so as to expose its posterior surface. The tumour is removed by a radial incision into the posterior surface of the organ or if necessary a sector of the breast

may be removed The cavity left is obliterated by buried sutures, the breast turned down into position and the skin incision sutured The operation though satisfactory unless the tumour is high up in the breast and justifiable where æsthetic considerations are dominant is not surgically desirable and should never be used unless the tumour is quite certainly non malignant. Such an extensive incision renders a subsequent operation for carcinoma on proper lines impossible.

Soft Fibro-Adenoma

The rare soft variety of fibro-adenoma is distinguished by its rapid growth, soft or elastic consistence and occurrence comparatively late in life.

A soft fibro-adenoma may originate from a hard one, or may be soft from the beginning Erichsen states that these tumours are commonest between the ages of 35 and 40 They are rapidly growing but innocent tumours which may in a few months attain the size of a cocoa-nut. But even when the soft fibro-adenoma attains a large size it remains mobile and painless, and does not display any tendency to adhere to the skin or fascia, or to cause enlargement of the glands. If these signs develop the tumour must be classified as a sarcoma

Soft adenoma differs from the hard variety in the nature of its stroma which is not composed of dense fibrous tissue poor in nuclei but is richly cellular It may be made up of fusiform cells sometimes mixed with more fully developed fibrous tissue. In other cases the tissue resembles myxomatous tissue, presenting stellate cells with abundant mucoid intercellular substance This appearance is probably the result of mucoid degeneration of ordinary fibrous tissue. Small cysts often occur in soft fibro-adenomas. The embryonic nature of the fibrous stroma of these tumours indicates their close connexion with the sarcomas, and indeed they were formerly called adeno-sarcomas.

The case recorded by Beatson and represented in Fig 238 is a typical instance of a large fibro-adenoma of the soft variety The patient was aged 50 and had noticed her right breast increasing in size for a period of two years. Pain was almost absent, and her health remained good. The tumour was situated in the upper hemisphere so that the stretched-out and flattened nipple is seen upon its under-surface The superficial veins were large and distended The breast felt very heavy but was freely movable under the skin and upon the fascia. The tumour was smooth, elastic and spherical but with some irregularity of shape and tendency to lobulation. The breast was not tender, nor were the axillary glands enlarged. The mamma was removed, and the encapsuled tumour weighed 6¼ lb. It was solid, but parts of it presented numerous cysts, while at other

parts the stroma had undergone mucoid degeneration. On microscopical examination the stroma (see Fig 259) was highly cellular and its appearance, apart from the clinical history would suggest sarcoma, except for the fact that epithelial structures usually disappear from a sarcoma of the breast.



Fig 258.—Soft, rapidly growing fibro-adenoma of the breast (so-called sero-cystic sarcoma of Brodie)

(*Beatson, Edin. Med. Journ. Nov., 1908.*)

Diagnosis.—Beatson points out that there are practically only three conditions which lead to the formation of really large tumours of the breast i e. soft fibro-adenoma (often cystic), hypertrophy and sarcoma. *Hypertrophy* is bilateral, while the other conditions are unilateral. A *sarcoma* if still encapsuled, cannot be distinguished from a soft fibro-adenoma. Only when a sarcoma begins to infiltrate

so that the breast becomes fixed and the skin involved can the diagnosis be made

Treatment.—Since soft fibro-adenoma is a large tumour to which the breast itself is merely a small appendage removal of the whole breast is usually preferable to enucleation The pectorals need not be removed nor the axilla opened



Fig. 259.—Microscopic section of the soft fibro-adenoma represented in Fig. 258. Note the cellular embryonic character of the stroma.

(*Renton* " *Edin. Med Journ.,* *Nov.,* 908.)

Cystic Fibro-Adenoma

Most large soft fibro-adenomas contain cysts. If these are of any size the tumour is called a cystic fibro-adenoma. A cystic fibro-adenoma may be produced from fibro-adenoma by the collection of fluid in the epithelial-lined spaces and chinks which represent the distorted original duct. This must obviously take place before the

stage of consolidation has begun When the cystic tumour is cut into fluid escapes and blunt foliated or lobulated masses are seen projecting into the interior of the cyst. Such a tumour must be clearly distinguished from cystic duct papilloma. Another form of cystic fibro-adenoma is due to partial or complete mucoid degeneration and liquefaction of the fibrous substance of the original tumour

A perfect tangle of nomenclature has grown up around this form of tumour Owing to the large size it rapidly reaches and the cellular character of its stroma it was formerly considered to be a sarcoma, and Brodie applied to it the name *sero-cystic sarcoma.* Johannes Müller called it *cysto-sarcoma.* French authors called it a cyst *adenoma*, a correct term, but one which has led to confusion between this form of tumour and the cystic duct papilloma (papillary cystadenoma) an absolutely different condition. For this reason the term cyst adenoma should be deleted from the nomenclature of breast tumours. Other names which have been applied to the cystic fibro-adenoma are *adenocele, cystoid glandular tumour* and *cystic fibroma.* These obsolete terms are recorded, not to burden the student's memory but as a key to the literature of the subject.

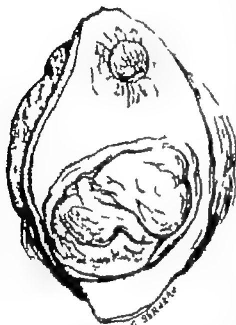


Fig. 260.—Fungating cystic adenoma of the breast. The edges of the skin are rolled back, not thinned and infiltrated as in sarcoma, and a mass of fibro-adenomatous tissue is protruding

(From specimen in the Middlesex Hospital Museum.)

Clinical features.—The characters of cystic fibro-adenoma are those of the soft fibro-adenoma from which it originates, except that areas of definite fluctuation, corresponding to the cysts, may sometimes be felt

Diagnosis.—A large tumour of the breast presenting fluctuating areas may be a cystic fibro-adenoma a cystic duct papilloma, or a cystic sarcoma The history or presence of serous discharge from the nipple distinguishes *duct papilloma*, while signs of infiltration will lead to the diagnosis of *sarcoma.*

Treatment.—The treatment is that of soft fibro-adenoma, and the prognosis is good

FUNGATING CYSTIC FIBRO-ADENOMA (FUNGATING CYSTADENOMA)

In very rare cases of cystic fibro-adenoma the skin over the cystic portion of the tumour becomes thinned and gives way Serous fluid escapes and blunt lobulated and foliated masses of fibro-adenomatous tissue project through the opening (*see* Fig 260) Septic and inflammatory changes may occur in the protruding mass, which becomes swollen and congested, and bleeds readily In such circumstances the simulation of a fungating sarcoma is very close though the tumour is really innocent In these days of early treatment of breast tumours this condition is rarely seen

Diagnosis.—A wedge of the protruding mass, ¼ in in depth, should be removed for microscopical examination No anæsthetic will be necessary

Treatment is that of soft fibro-adenoma which has been described on p 45

PURE ADENOMA[1]

In a pure adenoma the tumour is almost entirely composed of epithelial tubes more or less closely simulating normal acini, and separated by a minimal amount of supporting fibrous tissue, in which according to Ernest Shaw no fat is present. Owing to the absence of fat the lobular arrangement, so obvious in the normal breast, is obscured. Some of the gland tubes may be dilated into microscopic cysts, or may form irregular spaces encroached upon by convolutions of the epithelium Regularly formed ducts are absent. The epithelium, though apparently so active is everywhere confined within a basement membrane

Simple adenoma is one of the rarest of breast tumours, so that in a large experience it may be observed not at all, or once only It occurs at any age between puberty and the menopause. The case of pure adenoma which is represented in Fig 261 was observed by me in a girl of 16.

Clinically simple adenoma resembles a soft fibro-adenoma, though it does not seem to reach such a size. It does not adhere to the skin or fascia, but appears to be fixed in the breast. Enlarged veins may be seen coursing over it. In my own case (*see* Fig 261) the tumour appeared to constitute the whole breast and but for its unilateral character a diagnosis of hypertrophy would have suggested itself.

Treatment.—Enucleation should be attempted unless the tumour is very large In that case, amputation of the breast may be necessary

[1] *See also* Vol. I., p. 462.

growth of the papillomas, and the tumour is practically a solid one. In other cases one or more large, freely fluctuating cysts make their appearance, each containing only one or two papillomas (Fig. 262) The healthy lobes of the breast then appear merely as a small appendage to these cysts. The fluid in the cysts, or exuding from the nipple, is often clear and straw-coloured without cellular elements If hæmorrhage occurs the fluid takes on a shade of red In the cysts it exhibits similar gradations, and in the older cysts it may assume a brownish opalescent appearance which is associated with the presence of cholesterin.



Fig 264.—Typical duct papilloma. Its narrow base of attachment to the duct wall is seen upon the right of the figure. It presents a delicate branching framework of fibrous tissue, covered with a single layer of columnar epithelium. Note the absence of any sign of epithelial infiltration at the base of the papilla. × 10

Microscopical appearances.—The ducts of the breast are lined with a single layer of columnar epithelium. As might be expected therefore duct papillomas are composed of vascular branching cores of fibrous tissue covered with epithelium of the columnar type (Fig 264)

Clinical features.—Duct papilloma is usually painless. Pain may however occur upon the sudden cessation of serous discharge owing to the distension of the ducts by retained secretion. It may be felt at menstruation and at no other time. The patient's attention is attracted either by intermittent discharge which may be redder and more profuse during menstruation or by the discovery of a tumour The evolution of the disease is very slow and the discharge or tumour may be present for ten or more years before advice is sought. Suppuration of a duct papilloma with protrusion of the growths through an orifice formed by the bursting of the abscess, has been recorded

In all stages the tumour or tumours ar[illegible] ...vable in the breast, under the skin and upon the fasci[illegible] ...ary glands,

though from irritation they may become easily palpable are neither hard nor definitely enlarged. The nipple is not retracted nor is the breast shrunken But it is evident that the physical signs of duct papilloma will vary very greatly with the number of lobes affected, with the size of the papillomas with their degree of secretory power and with the presence or absence of obstruction of the ducts.

Early stage, tumour impalpable —Intermittent blood-stained or serous discharge is present One small segment of the breast corresponding to the particular orifice upon the nipple from which the discharge issues, is vaguely indurated and granular while the rest of the breast is soft and normal Careful observation shows that the discharge comes exclusively from the particular orifice upon the nipple which corresponds to the affected lobe and from none of the other orifices. Pressure upon the affected lobe increases the discharge while pressure upon the non-indurated parts of the breast is found to have no effect. The papilloma itself is too small to be palpable

Later stage, tumour palpable.—The papilloma has now become palpable as a small firm tumour situated beneath or near the nipple In some cases the papillomas may attain a considerable size and may form a solid tumour perhaps an inch in diameter But the nipple is not retracted, nor is the lump fixed in the breast The other signs are unaltered.

Cystic duct papilloma.—If a duct is blocked by the growth, serous discharge ceases. If the papillomas possess considerable secretory power the retained secretion distends the duct behind the obstruction. One or more cysts of considerable size are thus produced to which the remainder of the breast becomes a mere appendage. A large fluctuating swelling is present perhaps 4 in or more in diameter The solid papillomas which it contains cannot now be felt and the history of sanious discharge alone gives the clue to the diagnosis. Retraction of the nipple and adhesion to skin and fascia remain absent.

Fungating duct papilloma (*fungating papillary cystadenoma*) —In rare cases the skin over a duct papilloma may undergo a kind of pressure atrophy and may give way allowing the protrusion of the papillomatous masses. The same result may follow suppuration of a duct papilloma. Constricted by the margins of the skin opening, the protruding mass becomes congested and hæmorrhagic and closely resembles a fungating sarcoma It also simulates a fungating cystic adenoma. Malignancy may be excluded by the absence of fixation and of gland enlargement Microscopic examination of a portion of the fungating mass may decide its nature.

Treatment of duct papilloma.—The knowledge that a duct papilloma often becomes malignant should exert great influence upon its treatment. Duct papilloma is often a very circumscribed disease, affecting perhaps only one lobe of the breast In these circumstances mere excision of the affected lobe is very tempting but this policy is of doubtful wisdom. Since the eye is incompetent to map out the exact limits of the disease, and since early papillomas may be present in other ducts, it is much safer in view of possible malignant degeneration, to excise the whole breast even for early and limited duct papilloma In young women however it may be justifiable to resect the affected lobe or lobes leaving the remainder of the breast Treatment by buried radium is sometimes successful.

The axillary glands need not be removed But the specimen should be carefully examined for carcinomatous change, and if this is found or suspected the axilla must be cleared out at a subsequent operation.

LIPOMA AND MYXOMA

Most so-called *lipomas* of the breast are really paramammary lipomas occurring in contact with the breast, but not forming part of it.

Myxoma of the breast is merely a pathological curiosity It forms an encapsuled tumour resembling a fibro-adenoma.

CARCINOMA OF THE BREAST[1]

Etiology.—A carcinoma of the breast originates when the mammary epithelium which is normally confined within its basement membrane, escapes into the tissue spaces of the breast, and continues to proliferate therein

In females the breast comes second only to the uterus as a seat of election for malignant disease one case of malignant disease in every three affects the breast On the contrary only one case in every hundred of cancer in males is of mammary origin. The commonest sites of growth are in the upper and outer quadrant or beneath the nipple. Though no portion of the breast is exempt the lower and inner quadrant is the part most rarely affected. In exceptional cases the growth begins in an outlying lobule situated beyond the visible limits of the breast Campiche and Lazarus-Barlow find that the point of origin may be expressed in percentages as follows —

Beneath nipple[2]	12·2	Upper and inner quadrant	16·7
In nipple	7·6	Lower and outer	12·4
Upper and outer quadrant	44·9	Lower and inner	6·2

[1] *See also* Vol. I., p. 594.

[2] This table probably underestimates the frequency of growths beneath the nipple.

The proportion of married persons in the general female population above the age of 25 is about three out of four and three out of four cancers of the breast are seen in married women Thus the liability of married and unmarried women to cancer is about the same. Though a few striking family histories have been adduced the influence of heredity in this and in other forms of cancer is unproven Failure or inability to suckle at the breast, blows and injuries, a family history of tubercle, and a brunette complexion, have each been alleged as predisposing causes. A history of injury is present in about 10 per cent of cases of carcinoma but a relation of cause and effect has been proved only in rare cases

Trauma and carcinoma.—Injury to the breast due to malice or negligence or arising in the course of employment, and followed by the appearance of a carcinoma in the breast may assume considerable medico-legal importance. In order to establish a case of traumatic carcinoma it is necessary to prove (*a*) that the breast was previously healthy (*b*) that the injury was a single blow of sufficient severity to cause bruising and lead the patient to seek medical advice, (*c*) that the carcinoma developed at the exact site of the injury and (*d*) within a limited period not perhaps exceeding a year of the time when the injury was received. Further it should be shown, if possible, that after the palpable effects of the injury had passed off, and prior to the onset of the carcinoma, no tumour was present in the breast. In a case in which I gave evidence substantial damages were awarded in the English High Court for traumatic carcinoma of the breast due to an injury arising from the defendant's negligence. Counsel for the plaintiff in such a case should always lay stress upon the risk of recurrence after operation.

Age-incidence.—Carcinoma of the breast is unknown before puberty and very rare before 35 Most commonly it begins in the years immediately following the menopause. It remains frequent up to the end of life, in proportion to the reduced number of persons living at the more advanced ages.

Chronic mastitis as a precursor of cancer.—The most important factor in the production of breast cancer appears to be chronic mastitis. Taking first the *clinical* evidence, Bryant found that out of 360 cases of cancer mastitis had occurred at some antecedent period in 80 Gross found similar evidence in 71 of 365 cases of cancer Sheild found evidence of past inflammatory trouble in only 10 per cent. of the St. George's Hospital cases, but he justly points out that a focus of chronic mastitis much too small to be clinically appreciable may yet form an adequate nidus for a carcinoma. The clinical statistics, then, amount only to this—that there is evidence of past chronic mastitis in a large minority of cases of breast cancer

The *pathological* evidence however in favour of chronic mastitis as a cause is very strong Beadles, from the examination of the non-carcinomatous portions of 100 cancerous breasts at the Brompton Cancer Hospital, found without exception in each of these breasts such abnormal changes as undue proliferation of the acini and of the stroma, and cysts were of common occurrence. F T Paul, as the result of prolonged observations recorded in 1901 his belief that microscopical evidence of mastitis is present in nearly every breast affected with carcinoma. Later Victor Bonney found traces of chronic mastitis in all the mammæ removed for early carcinoma which he had the opportunity of examining Thus, pathological investigation shows chronic mastitis to be an almost universal precursor of carcinoma. It is, however in the ducts that most carcinomas arise as Lenthal Cheatle has shown. It has already been pointed out that chronic mastitis is usually accompanied by a chronic duct catarrh, and it is in the columnar epithelium of the chronically inflamed and obstructed ducts that the cancer usually arises. The so-called spheroidal-celled carcinoma is usually a duct carcinoma in which the cells have lost their original columnar character.

Fibro-adenoma and carcinoma—General opinion favours the view that there is no connexion between fibro-adenoma and carcinoma At first sight nothing could appear more innocent than a fibro-adenoma of the breast, persisting possibly for years without notable increase in size, and securely walled off from the normal tissues by its strong fibrous capsule. Yet, in my opinion there can be no reasonable doubt that in a small proportion of cases malignant tumours may arise in or in connexion with these innocent neoplasms. Fibro-adenomas are often enveloped in an area of breast tissue exhibiting chronic mastitis which certainly may lead to cancer It seems, then, probable that the irritative effect of a fibro-adenoma may be an important factor in inducing cancer in the surrounding breast tissue. This view is confirmed by the fact that the seat of election for breast cancer—the upper and outer quadrant, including the axillary tail—is also the seat of election for fibro-adenoma

Is it possible, apart from the irritative effect of a fibro-adenoma upon the surrounding tissues, that the tumour itself may undergo a carcinomatous degeneration ? On various occasions I have observed in microscopical sections of breast cancer an intimate admixture of carcinomatous and fibro-adenomatous tissues, so that the histological appearances of these diverse tumours should be seen together on the same field of the microscope. Such observations, though suggestive, are not conclusive. There is, however in the museum of St. Bartholomew's Hospital (3159c) an encapsuled acinous fibro-adenoma containing a central opaque area of spheroidal-celled carcinoma which



Naked-eye section, prepared by Rowntree a modification of the writer's translucent strip method of a fibroid cancer of the breast removed by operation. The section passes at its right hand end through the axillary tissues, and carcinomatous lymphatic glands are seen buried therein. The growth in the breast substance has caused retraction of the nipple. It is seen as a greyish area of fibrosis sending fibrotic prolongations in various directions. (Contrast Plate 82.) Along the lower edge of the section is seen the great pectoral muscle, on the upper edge the area of skin removed.

PLATE 81



A similar section to that shown in Plate 81 from a soft or medullary cancer of the breast. The section passes at the left hand end through the axillary tissues, in which numerous enlarged lymphatic glands are seen embedded. Along the lower edge of the section is seen the pectoralis major. The growth is pinkish in colour and has not the scar like appearance illustrated in Plate 81.

PLATE 82.

If the epithelium proliferates very rapidly a soft bulky tumour is produced, rich in epithelium, and called a medullary carcinoma (Fig 265) If, on the other hand, the proliferative power of the epithelium is low while the fibrotic processes are active the "atrophic scirrhus" of old age results. If these two opposing processes are balanced, a hard tumour of not inconsiderable size, the ordinary scirrhus, is produced. The name scirrhus is often reserved for those carcinomas where the epithelium has lost its tubular arrangement (Fig. 266) If the epithelium possesses sufficient power of cohesion to retain in some degree its arrangement in gland tubes the name acinous carcinoma or adeno-carcinoma is applicable (Fig. 267)



Fig. 266.—Typical appearance in chronic fibroid cancer of the breast. In a groundwork of dense fibrous tissue are embedded single lines of compressed and deformed cancerous epithelium. The terminal cells of the line are usually triangular in shape. × 160.

It is important to recognize that all gradations occur between the forms of carcinoma which have just been named, and, moreover that these gradations may occur in the same tumour Thus, one part of a tumour may present a medullary appearance, while an older part shows a densely fibroid growth containing few epithelial cells It must be remembered that a mass of cancer cells becomes increasingly fibrotic with age. But it is clinically convenient to classify the tumour according to its size and hardness as medullary cancer scirrhus and atrophic scirrhus.

Diffuse carcinoma of the breast.—Cancer of the breast usually begins in one small district of the breast if not at one microscopic point, and is correctly described as unicentric in origin. Cases are, however met with where the whole breast or several of its lobes appear to undergo carcinomatous degeneration *en masse*, the disease lighting up simultaneously in every part of an extensive district. These cases may be described as multicentric carcinoma, diffuse scirrhus, or diffuse carcinoma. They include the most virulent forms of breast cancer and the term diffuse carcinoma

may perhaps be regarded as the pathological equivalent of the clinical term acute carcinoma or mastitis carcinomatosa (*see* p 86)

Dissemination of Breast Cancer

It is of primary importance to know the mode and channels by which breast cancer spreads from the primary focus and gives rise to secondary deposits, for in the absence of this knowledge it is impossible to devise a scientific operation for the extirpation of the disease.

Until recently the subject of dissemination was enveloped in confusion and uncertainty It was believed that the secondary deposits situated near the primary growth arose from particles carried along the lymphatics by the current while more distant deposits, such as those in the liver were accounted for by the *embolic theory* According to this theory particles of the primary growth reach the blood by way of the axillary and supraclavicular glands, and are carried by the force of the circulation to remote districts where their cells proliferate and produce secondary nodules. Although in 1889 Heidenhain found lymphatics filled with cancer cells extending from the breast to the pectoral fascia in two-thirds of the cancerous breasts he examined, this important observation remained isolated, and had no effect upon the general doctrine of dissemination. Stiles, whose work upon the surgical anatomy of the breast led to such great operative improvements, writing in 1889 continued to share the embolic view of dissemination.



Fig 267 — Columnar celled adeno-carcinoma of the breast originating in the smaller ducts. Note the irregular shape of the gland-spaces. At other points in the growth infiltration had occurred, and the cancer cells had lost their gland like arrangement. × 68.

Although it has been conclusively shown especially by M. B. Schmidt, that cancer cells often obtain access to the blood-stream, upon a close examination the embolic theory presents many diffi-

culties. Stephen Paget pointed out that, though embolism must be an impartial process to which all the organs are liable, certain organs are very prone and others relatively immune to secondary deposits of cancer Thus, in pyæmia a known embolic process, the frequency of splenic to hepatic abscess is as two to three. In breast cancer the frequency of splenic to hepatic metastases is only as one to fourteen. Again, the distribution of the secondary deposits is not the same for instance, in cancer of the uterus as in cancer of the stomach but varies according to the site of the primary growth. Yet embolism must be by its nature an impartial process. In cancers which affect the skeleton the secondary deposits are frequent in certain bones and very rare in others, although all the bones must be liable to embolism. These difficulties have never been convincingly met by the advocates of the embolic theory In most cases, cancer cells which gain access to the blood-stream appear to undergo destruction. The details of the process, as seen in the lungs, have been demonstrated by M. B Schmidt The peculiarities of metastatic distribution, to be further referred to show that blood embolism is a comparatively unimportant factor in dissemination.

PARIETAL AND VISCERAL DISSEMINATION

The secondary deposits in breast cancer may be considered under two headings—first, those in the parietes of the thorax, abdomen, and head or in the limbs second, the visceral deposits within the thorax, the abdomen or the central nervous system.

Dissemination in the parietes.—In certain cases widespread deposits are found in the bones or the subcutaneous tissues, while the internal organs are free from cancer The escape of the internal organs in such cases is very difficult to explain if the seeds of the secondary deposits are distributed by the blood-stream. Moreover on the embolic hypothesis subcutaneous nodules might be expected to crop up at random anywhere upon the surface of the body This is not the case. The subcutaneous nodules which are so frequently seen in breast cancer always make their earliest appearance close to the primary growth Moreover I have shown that they spread away from the growth in a centrifugal manner and occupy an area, roughly circular, which has for its centre the primary growth. In course of time and in exceptional cases this circle may occupy the greater part of the surface of the body and may spread to the limbs and head. But almost invariably the patient dies before subcutaneous deposits have made their appearance upon the distal portions of the limbs—the situation, of all others, where embolic particles might be expected to lodge. The arms below the deltoid insertion, and the lower limbs below the middle third of the thigh, appear invariably

to remain free from nodules. The distal portions of the limbs enjoy an immunity from bone metastases as well as from subcutaneous nodules. The following table shows the experience of the Middlesex Hospital in this respect for a period of thirty years —

TABLE SHOWING THE FREQUENCY OF CANCEROUS DEPOSIT OR SPONTANEOUS FRACTURE IN 329 CASES OF MAMMARY CANCER AT THE MIDDLESEX HOSPITAL, 1872–1901

	Bone	*No. of cases*	*Percentage of total*
Bones lying wholly or partially within the area liable to subcutaneous nodules	Sternum	30	9·1
	Ribs	28	8·5
	Clavicle	5	1·5
	Spine	12	3·6
	Cranial bones	9	2·7
	Scapula	1	0·3
	Femur	14	4·2
	Os innominatum	—	—
	Humerus	9	2·7
Bones lying beyond the area liable to subcutaneous nodules	Radius	—	—
	Ulna	—	—
	Tibia	1	0·3
	Fibula	—	—
	Patella	1	0·3
	Bones of hand	1	0·3
	Bones of foot	—	—

Owing to the impossibility of making a complete routine examination of the skeleton, it is probable that this table is incomplete, that secondary deposits in the flat bones especially—bones which, owing to their shape, are not liable to fracture as the result of secondary growth—are more frequent than the table would indicate. But advanced cancerous deposit in the bones of the forearm and leg would certainly give rise frequently to spontaneous fracture and would thus attract the attention of the pathologist. The immunity of the long bones of the forearm and leg must, therefore, be a real, not merely an imaginary one.

The table includes two cases which form exceptions to the rule just stated. In the first case, owing to ankylosis of the knee-joint, cancer had extended to the tibia and patella by continuity from the femur. In the second case certain of the metacarpal bones were fractured. In this case, therefore, it appears probable that cancerous embolism along the blood vessels was the cause of the spontaneous fracture. But it is a very striking fact, as indicating the inefficiency of blood embolism in the causation of bone metastasis, that only one case in thirty years showed bone deposit in the distal portions

of the limbs. Judging by the frequency of non-cancerous embolism of the extremities, it is in these that bone deposits, according to the embolic theory should most frequently occur. It is noteworthy also that cancerous deposit in the femur with the rarest exceptions, commences in the upper third of the bone. The intimate connexion of the periosteum with the deep fascia in the region of the great trochanter facilitates the invasion of the bone in the trochanteric region as soon as permeation has spread so far Moreover spontaneous fracture of the humerus occurs most frequently at the level of the deltoid insertion. As in the femur fracture occurs most often at the point nearest the trunk at which the bone is subcutaneous, and consequently in close relationship with the fascial lymphatic plexus. Speaking generally the liability of a bone to cancerous deposit or spontaneous fracture increases with its proximity to the site of the primary growth. All these peculiarities, difficult to explain on the embolic theory show the working of a slow centrifugal process of spread from the primary focus.

Alfred Piney in an able paper has recently shown that groups of cancer cells may be found in the blood vessels of the red marrow at the earliest stage of cancerous invasion of the bone and before any periosteal deposits can be detected. He has further shown that cancer develops only in red and not in yellow marrow and that at the proximal ends of the femur and humerus red marrow persists throughout life. An explanation, consistent with the theory of blood-dissemination, is thus afforded for the preference of cancer for the proximal ends of these bones. Nevertheless, Piney does not explain why spontaneous fracture of the femur is three times more common on the side of the primary growth in the breast than on the opposite side, and, until this crucial question is answered, the problem whether the cancer cells are taken to the bone by lymphatic permeation or by blood embolism must remain open for discussion. Piney has himself shown that while the marrow itself contains no lymphatics, the periosteal lymphatics communicate with a system of endosteal lymphatic vessels in close contact with the marrow

Taking centrifugal spread in the parietes as proved the question arises, In what plane does the growth spread? On the assumption that the growth could spread along the skin to a considerable distance many operators have advocated the ablation of very large areas of skin. My researches show that invasion of the skin is secondary to spread in the plane of the deep fascia. The skin nodules are isolated efflorescences springing up from below and the skin is not a highway for the spread of cancer The growth spreads in the plane of the deep fascia because in this layer is situated the main parietal lymphatic plexus, the fascial plexus. The results of operators who remove

large areas of skin are less satisfactory than those of surgeons who remove less skin and a wider extent of deep fascia In my own series of cases although the skin removed is only a circle of four or five inches, but few instances of recurrence in the skin have come to notice

Dissemination within the limits of the breast—Langhans was the first to notice that the small lymphatics of the breast are invaded early and widely far beyond the infiltrating edge of the primary growth. Stiles showed that the breast is a far more wide spreading organ than it appears to be and that for its complete removal shown to be imperative by Langhans observations an extensive operation is necessary

Extension of growth to the pectoral fascia—Heidenhain, in 1889, showed that in two cases out of three lymphatics filled with cancer cells are present upon the pectoral fascia. In opposition to Langhans he maintained that the process is one of *continuous growth along the vessels*, not one of lymphatic embolism Invasion of the lymph atics of the pectoral fascia precedes the clinical sign of adhesion of the growth to the fascia.

Embolism of the axillary glands—Embolic invasion of the axillary glands along their afferent trunks almost invariably occurs as soon as the lymphatics of the pectoral fascia have been invaded In the earliest stage a few cancer cells are seen lying in the subcapsular lymph sinus at the point of entry of the afferent lymphatics (Stiles) The cells slowly penetrate to the interior of the gland by infiltrating its lymph spaces, and ultimately reach the efferent lymphatics, along which they may be swept to the supraclavicular glands. At the same time they are infiltrating the capsule of the gland which con sequently loses its mobility upon the surrounding structures.

The lymphatic glands delay for a long time the further advance of the cancer cells and there is evidence that they may destroy cancer cells brought to them, and that they only succumb to invasion after a prolonged resistance. It is important to note that widespread dissemination may occur in cases where, after death the axillary glands are found to be free from cancer In fact the route which leads through the axillary glands is only a by way of dissemination, and not the main avenue.

Invasion of the opposite axillary glands and of the opposite breast.—In a late stage of breast cancer owing to extension of permeation across the middle line enlargement of the opposite axillary glands often occurs. A little later deposits of growth are noted in the opposite breast. It is only in rare cases that such a deposit is a second primary growth (Fig 275) In a few cases the inguinal glands undergo enlargement, showing that permeation has extended below the level

of the umbilicus into the region of the main tributaries of the inguinal glands. Embolic invasion of the inguinal glands then becomes a possibility

The permeation theory (Fig 268)—Although the force of the lymph-stream carries cancer cells to the axillary glands, they are there filtered off and detained. If a reflux lymph-stream carries them towards the opposite breast they are similarly filtered off and detained, near the middle line, in the meshwork of fine vessels which forms the only lymphatic communication between the opposite sides of the body Thus the force of the lymph-stream is ineffective as a means of *general* dissemination it is effective only within the limits of the lymphatic area in which the primary focus is situated. In whatever direction the cancer cells attempt to leave that area they find an effective filter blocking the way But they do actually succeed in leaving it, as the facts of dissemination show An illustration will make clear the method by which they overcome the obstacles to their spread into other lymphatic areas. Certain bacteria, which cannot be forced through a porcelain filter will nevertheless, if left in it for a few days, grow through its pores and infect its outer surface. In the same way cancer cells are able to traverse the lymphatic plexuses by actually growing along the fine vessels which compose them. This process, which I have called *permeation*, is the master process of dissemination for no barriers exist to stop its slow centrifugal progress. Permeation spreads in all directions with approximate equality independently of the direction of the lymph-stream, but keeping in the plane of the main lymphatic plexus until the pressure within its vessels forces the cancer cells up its minute tributaries to invade the adjacent layers. That is to say in the case of the breast, the deep fascia will be extensively invaded over a circular area of which the primary growth is the centre, while a smaller circular area of the skin and of the subjacent muscles will show permeation or nodular deposits.

Perilymphatic fibrosis.—In view of its importance it may seem strange that the process of permeation so long eluded notice In certain situations, such as the pleura, where it is sometimes visible to the naked eye, it had been described under the name *lymphangitis carcinomatosa*, but its importance remained unsuspected and it was regarded as a pathological curiosity Large areas of a tissue thickly sown with cancer nodules may be examined without finding any trace of permeation. Such nodules, it was therefore argued, must have resulted from embolism and the argument appeared conclusive until I detected the crucial fact that a lymphatic along which cancer cells have pushed their way does not persist unchanged. The cancer cells by their continued growth distend and finally rupture the lymphatic. An inflammatory reaction is set up, abundant round

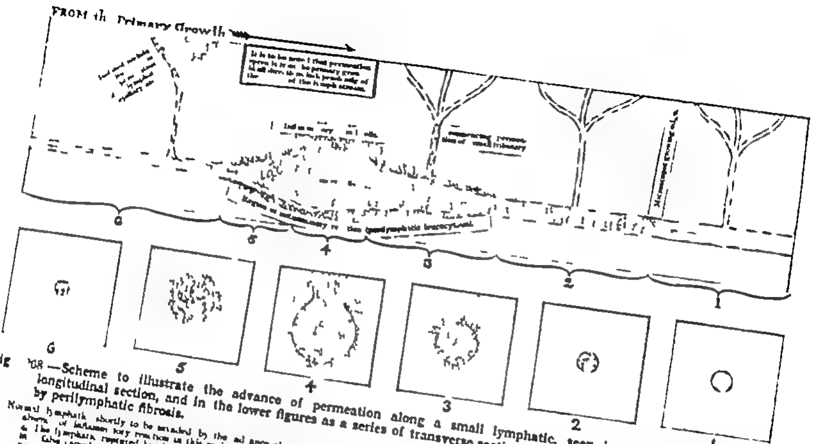


Fig. 108.—Scheme to illustrate the advance of permeation along a small lymphatic, seen in the upper figure in longitudinal section, and in the lower figures as a series of transverse sections. The lymphatic is finally destroyed by perilymphatic fibrosis.

1. Normal lymphatic shortly to be invaded by the advance along it of permeation. 2. Lymphatic permeated by cancer cells, but not yet distended. (Note the absence of inflammatory reaction in this region.) 3. The lymphatic distended by the growing cancer cells; the central cancer cells are becoming degenerate. 4. The lymphatic ruptured by the growing cancer cells, an event followed by a vigorous inflammatory reaction. 5. The mass of degenerate cancer cells enclosed in a false capsule of newly formed fibrous tissue. 6. The cancer cells are finally strangled by contraction of their fibrous capsule. The original lymphatic is now represented simply by a thread of fibrous tissue, the cancer cells having been destroyed.

celled infiltration occurs round the liberated cylinder of cancer cells, the vitality of which has been much impaired by pressure, and a capsule of newly formed fibrous tissue contracts upon and strangles the degenerate cancer cells. Finally the original lymphatic is replaced by a solid thread of fibrous tissue in which no cancer cells can be seen. This process may be called *perilymphatic fibrosis*. While it is taking place, cancer cells forced along the lymphatic capillaries may have originated nodular and apparently isolated deposits in the adjoining layers.

The tendency of a carcinoma to drag in towards itself the surrounding apparently healthy tissues is an inevitable consequence of the process of perilymphatic fibrosis, for the contraction of the new fibrous tissue threads replacing the normal network of lymphatic vessels, leads to a general puckering and shrinkage of the affected zone. The process of perilymphatic fibrosis is especially interesting because it is an example of the local cure of cancer by natural processes (see p. 72). But the cure is local only for the fibrotic process fails to overtake the spreading edge of permeation, which has meantime invaded new districts of the lymphatic system.

Owing to the regular centrifugal spread of permeation in an ever widening circle away from the primary growth three zones of cancerous infection can be distinguished around the obvious primary growth.

1 The inner zone of isolated or confluent *secondary nodules*. In this zone the permeated lymphatics have been destroyed.

2. A narrow zone in which *perilymphatic fibrosis* is actively progressing, and in which invasion of the layers adjacent to the main lymphatic plexus is seen in an early stage.

3 The *microscopic growing edge* or outer zone of fascial permeation This zone is clinically inappreciable, for the infection is purely microscopic. The lymphatic vessels are choked by cancer cells, while infiltration is absent—that is to say the interstices of the tissues are free from cancer cells. The microscopic growing edge is found in the plane of the deep fascia where the main lymphatic plexus is situated. The clinical importance of this fact cannot be over estimated.

The detection of the microscopic growing edge in the deep fascia is the primary fact upon which the permeation theory rests. It is a zone but a few millimetres wide, and it can only be detected by taking sections radiating from the growth far into apparently healthy tissues, and by examining these sections in their whole length But this, the true growing edge of the cancer though inappreciable by ordinary methods of examination, is just as definite and real as the visible spreading edge of a ringworm or of a tertiary syphilide. At first the microscopic growing edge forms a small circle immediately

around the growth but it constantly increases in size until it may attain a diameter of 2 ft. involving the scalp above, reaching the groins below and enveloping the back

Visceral dissemination.—Although the permeation theory of dissemination seems the only tenable one so far as the superficial metastases are concerned, it might appear at first sight necessary to invoke the embolic theory to explain secondary deposits in the viscera. Careful investigation shows that this is not the case. The visceral metastases in breast cancer mainly arise from permeation along the numerous fine anastomoses which piercing the parietes, connect the lymphatic plexus of the deep fascia with the subendothelial lymphatic plexuses of the pleura and the peritoneum, and with the mediastinal and portal glands. But as soon as the subserous plexus is reached, permeation is relegated to a subsidiary position for the cancer cells soon erode the overlying endothelium and escape into the serous cavities. Under the influence of muscular movements and of gravity the cancer cells become widely diffused throughout the invaded cavity and implant themselves upon the serous surfaces of the various organs. Here they grow and originate secondary deposits. This mode of cancerous dissemination may be called *transcœlomic implantation*. It only occurs very late in the disease but once initiated it rapidly leads to the death of the patient

In accordance with this view is the fact that the thorax and the abdomen may be invaded independently That is to say after death secondary deposits may be found only in the thorax and not in the abdomen, or only in the abdomen and not in the thorax—a fact for which the embolic theory fails to account Moreover as might be expected, the presence of serous (non-cancerous) adhesions is found to delay dissemination by hindering transcœlomic implantation The secondary deposits, too in the serous cavities show a preference for the serous surfaces of the viscera and, owing to the action of gravity tend to affect the lower limits of the serous cavities, especially the pelvis.

Epigastric invasion of the abdomen.—According to the researches of Stiles, the lower and inner margin of the breast overlies the sixth costal cartilage—that is to say this part of the mammary circumference is distant only about an inch from the epigastric angle. In the epigastric angle the deep fascia is separated from the subperitoneal fat and the peritoneum only by a single layer of fibrous tissue, the linea alba. As soon as fascial permeation has spread an inch beyond the margin of the breast cancer cells are thus brought into close proximity with the peritoneal cavity and they have only to infiltrate the linea alba and pass through the loose subserous fat before reaching it. This mode of abdominal invasion, which I have traced

microscopically in all its stages, may be called *epigastric invasion*. Reaching the peritoneum by this route the cancer cells first implant themselves upon the convex upper surface of the liver close to the falciform ligament. Other cancer cells may fall into the pelvis and give rise to deposits filling the pouch of Douglas, or to secondary ovarian growths. Epigastric invasion probably occurs sooner or later in at least one case in three. It is especially likely to supervene early in cancers affecting the lower and inner quadrant. It may be suspected when epigastric pain and tenderness are present, even apart from hepatic enlargement and jaundice, and may be diagnosed with confidence if subcutaneous nodules are present in the epigastric region. The acuter forms of epigastric invasion are accompanied by vomiting



Fig 269—Infiltration in breast cancer Narrow columns of cancer cells are growing along the cellular interspaces. × 20 Cf Fig. 270

Other modes of invasion of the abdomen.—The retroperitoneal abdominal organs, especially the liver kidneys, and suprarenals, or the lumbar spine may be attacked by the downward extension of permeation through the diaphragm from pleural deposits. This may be called retroperitoneal invasion of the abdomen. In rare cases the peritoneal cavity may be reached, when the pleura is already cancerous, by cancerous infiltration of the anterior portion of the diaphragm (diaphragmic invasion)

Invasion of the thorax—Breast cancer may reach the interior of the thorax in several ways. (*a*) Permeation may extend by means of lymphatic anastomoses piercing the anterior end of the intercostal spaces, to the anterior mediastinal glands, and thus to the other thoracic glands and to the pleura. Post mortem records appear to show that this is rare, for cancerous anterior mediastinal glands are found in only 6 5 per cent. of necropsies on breast cancer, but their evidence is contradicted by recent clinical experience. Modern methods of operating have almost abolished the local recurrences formerly so

common, but recurrence at the inner ends of the upper intercostal spaces occurs after several years interval with disappointing frequency It shows that at the time of the original operation cancer cells had already obtained access to the anterior mediastinal glands. (b) The pleural cavity may be invaded by direct infiltration of the chest wall beneath the primary growth. (c) Cancerous supraclavicular glands may become adherent to the dome of the pleura. Subsequently cancer cells infiltrate the pleura and escape into the pleural cavity

Thoracic dissemination may be delayed or prevented by the presence of old pleural adhesions

Secondary deposits in the brain — Secondary deposits occur in the brain in about 4 per cent of cases, and in the dura mater with about the same frequency They may be due to blood invasion but often they result from upward permeation along the cervical lymphatics from enlarged supraclavicular glands.



Fig. 270.—A permeated lymphatic in longitudinal section. The endothelium of the lymphatic is visible outside the mass of cancer cells which fills it. Above it is seen a normal blood-vessel. Infiltration of the tissues is absent. × 160. Cf. Fig. 269

(From Handley, "Cancer of the Breast and its Operative Treatment.")

Permeation and infiltration contrasted —Some recent writers have used the terms permeation and infiltration indiscriminately and it will be well to lay down clearly the differences between these two modes of spread of carcinoma and to indicate their relative importance.

INFILTRATION (Fig. 269)	PERMEATION (Fig. 270)
In point of time, the earliest disseminative process.	In point of time, begins after infiltration.
Best seen at the edge of the primary growth, as defined by the naked eye.	Best seen at the *microscopic growing edge*, which, in advanced cases, may be situated in apparently normal tissues, 6 in. or more from the apparent edge of the primary growth.

Infiltration (Fig 269)	Permeation (Fig. 270)
The cancer cells are spreading along the tissue interspaces, e.g. between fat cells, or between adjoining fibrous bundles. (*See* Fig. 269)	The lymphatic vessels, not the lymphatic spaces, are filled up and choked by solid cords of cancer cells. The tissue interspaces are free from cancer cells. (*See* Fig. 270.)
If infiltrating cancer cells intrude into a capillary lymphatic vessel the process of infiltration merges into that of permeation.	If a permeated lymphatic ruptures, the cancer cells set free may infiltrate the surrounding tissues. Thus permeation may lead to infiltration.
Infiltration is a very slow process, because of the resistance offered to the passage of cancer cells through the cramped and tortuous tissue interspaces.	Permeation is a more rapid process than infiltration, because the cancer cells are growing with little resistance along the open lumen of the lymphatic vessels.
Infiltration, on account of its slowness, is of relative unimportance as a factor in general dissemination.	Permeation may carry cancer cells to a very considerable distance from the primary tumour, and is capable of traversing the minute anastomotic lymphatic plexuses. It is accordingly the principal factor in general dissemination.

Summary.—It will be clear from what has been said that the processes concerned in dissemination are mainly three in number—(*a*) permeation (*b*) infiltration (*c*) transcœlomic implantation. To these must be added, as playing subsidiary parts—(*d*) lymphatic embolism, which leads only to gland deposits, and (*e*) blood embolism, which is usually ineffective owing to the inability of the cancer cells to colonize the blood-stream.

Effects of lymphatic obstruction in breast cancer—Certain of the later manifestations of breast cancer do not depend upon actual cancerous growth, but upon interference with the return of lymph from the affected part owing to obstruction of its lymphatics by permeation and perilymphatic fibrosis. The changes due to lymphatic obstruction are seen in the skin, the arms and the serous cavities, and need brief separate consideration in each of these situations.

"Pig skin" or "peau d orange—One of the most characteristic signs of cancer of the breast in a somewhat advanced, though perhaps still operable, stage is the appearance known as pig-skin or *peau d'orange*. In this condition the orifices of the sebaceous glands, normally just visible become enlarged and deepened, to form obvious dotted depressions, sometimes blackened and emphasized by ingrained dirt. The affected skin is obviously thick and leathery and has lost its suppleness. It overlies the carcinoma and is usually adherent to

it, but later the surrounding skin may be involved to a considerable distance (Fig 271) It is sometimes erroneously stated that orange rind integument is seen only in carcinoma. Although due to cancer in nearly all cases, it may occur in syphilis in tuberculous in cold abscess of the breast and in elephantiasis

Pathology—It has been taught until recently that *peau d'orange*



Fig 271—Carcinoma of the breast, showing retraction of the nipple, and marked and extensive *peau d'orange*

depends upon the anchorage of the breast to the overlying skin by means of the fibrous bands called the ligaments of Astley Cooper and that it is produced by the contraction of these ligaments following their invasion by growth This view appears to hold an element of truth but, since an identical appearance may be seen upon the skin in elephantiasis, the explanation is incorrect. Leitch has shown convincingly that the appearance is due to lymphatic stasis i.e. by lymphatic oedema. Where the skin is transfixed by hair follicles it is unable to swell, and at these points

Infiltration (Fig 269)	Permeation (Fig. 270)
The cancer cells are spreading along the tissue interspaces, e.g. between fat cells, or between adjoining fibrous bundles. (*See* Fig. 269)	The lymphatic vessels, not the lymphatic spaces, are filled up and choked by solid cords of cancer cells. The tissue interspaces are free from cancer cells. (*See* Fig. 270)
If infiltrating cancer cells intrude into a capillary lymphatic vessel the process of infiltration merges into that of permeation.	If a permeated lymphatic ruptures, the cancer cells set free may infiltrate the surrounding tissues. Thus permeation may lead to infiltration.
Infiltration is a very slow process, because of the resistance offered to the passage of cancer cells through the cramped and tortuous tissue interspaces.	Permeation is a more rapid process than infiltration, because the cancer cells are growing with little resistance along the open lumen of the lymphatic vessels.
Infiltration, on account of its slowness, is of relative unimportance as a factor in general dissemination.	Permeation may carry cancer cells to a very considerable distance from the primary tumour, and is capable of traversing the minute anastomotic lymphatic plexuses. It is accordingly the principal factor in general dissemination.

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obvious pits are seen comparable to the buttoned depressions in a stuffed arm-chair The occurrence of the lymphatic obstruction is explained by the facts of permeation (see p 62).

Cancerous pachydermia (cancer en cuirasse).—In certain cases of breast cancer the skin over and round the tumour becomes hypertrophied, leathery and thickened The condition just described as pig-skin is the earliest sign of this pachydermatous change. Usually the skin retains its normal colour and does not pit on pressure. In the late stage of the affection cancerous nodules, which may ulcerate, appear here and there in the affected area, and the skin previously leathery now becomes hard and brawny purplish or red in colour and perhaps covered by rough desquamating crusts. Cancerous pachydermia first appears over the primary growth and spreads from it in all directions, involving an increasing and roughly circular area which ultimately includes the whole of the front of the chest, and encroaches on the abdomen, neck, and back. It is usually associated with "brawny arm" and in its latest stages both arms may be swollen. (Fig 272 and Plate 83.)

In an extreme instance of cancerous pachydermia recorded by Velpeau, the skin was affected from the umbilicus to the larynx, and from the loins to the occiput. The thickened skin was sown with scirrhous ulcers and closely-set cancerous bosses. The arms were tripled in bulk, and as hard as marble. The respiration resembled that of a person whose chest is gripped in a vice, and the arms and head were immovable, while pain in the arms was constant and terrible, so that the sufferer longed for death. In such cases asphyxia may be the actual cause of death.

The condition I have just described was regarded until recently as due to cancerous invasion of the skin, and this view is correct as regards the later stages. But if the thickened skin be examined in the early stage of leathery hypertrophy no cancer cells can be found in it and I have shown that the condition is one of lymphatic œdema, the changes being identical with those met with in the skin of elephantiasis. The altered skin of the breast may sometimes attain a thickness of 6 mm. before any cancer cells can be detected in it.

The factor which causes lymphatic obstruction is cancerous permeation and subsequent fibrotic obliteration of the underlying fascial lymphatic plexus and its tributaries. The name *cancerous pachydermia* is thus the most appropriate which can be found. The name *cancer en cuirasse* should be reserved for the later stage of cancerous pachydermia in which the skin shows nodular or diffuse cancerous infiltration

The "brawny arm" of breast cancer.—In a late stage of breast cancer the corresponding arm often becomes swollen and œdematous.



Carcinoma of the breast of atrophic type showing early "cancer en cuirasse." The breast and skin are firmly fixed to the thorax. Lymphatic œdema of the skin is present as high as the clavicle and beyond the middle line in front.

([illegible] of Belfast, to whom [illegible] indebted for [illegible] beautiful [illegible] photograph [illegible])

PLATE 83.

obstruction, a view shown to be incorrect by the absence of œdema after resection of the axillary veins. It has been said to be due to obstruction of the lymphatic trunks by growth outside or within them. If this were the case it should invariably occur in an early stage of the disease, for cancerous infiltration of the axillary glands must necessarily obstruct the trunks which lead to them. In point of fact lymphatic œdema of the arm is a consequence of the spread of permeation to the lymphatic plexuses about the shoulder and of the subsequent conversion of the permeated vessels into solid cords of fibrous tissue. The arm is thus completely cut off from the lymphatic circulation, while at the same time transudation is increased by the pressure of the fibrotic lymphatic vessels upon the small veins which usually accompany them. No collateral circulation can be established, and the limb necessarily falls into a condition of lymphatic œdema.

The treatment of this condition is discussed at p 101

Serous effusions in breast cancer.—The collection of fluid in the serous cavities is a sign that the patient has at most but a few months to live. Sometimes pleuritic effusion appears only a day or two before death, and in such cases it is due to terminal heart failure. But generally it appears to depend upon lymphatic obstruction and more especially upon permeation of the subpleural lymphatic plexus, which may be completely injected with cancer cells (so-called lymphangitis carcinomatosa) This condition is recognizable post mortem by the naked eye The pressure of enlarged cancerous glands must also be regarded as a cause of pleuritic effusion. Similar factors are at work in causing ascites, and the distension of the abdomen may be extreme. It is thus obvious that lymphatic obstruction is often the proximal cause of death in breast cancer

Serous effusions causing distress should be treated by aspiration but sometimes the interference is not worth while.

Natural regression or repair in breast cancer—The close observation of breast cancer has shown that occasionally in cases running their natural course, and in the absence of all treatment subcutaneous secondary deposits may shrink and disappear enlarged glands may become impalpable, cancerous ulcers may completely heal, and osseous union may take place in bones fractured as the result of secondary deposits.

One case recorded by Pearce Gould presented numerous thoracic subcutaneous nodules, enlarged and hard glands above the clavicles and in the axillæ, spontaneous fracture of the left femur and great dyspnœa and emaciation. All the deposits spontaneously disappeared within a few months, and the patient remained well for at least three years.

The most probable explanation of these facts is that certain processes of repair which in exceptional cases may become clinically

manifest by the disappearance of massive secondary deposits, are a normal part of the cancer process. In a mass of cancer cells, owing to nutritional difficulties, the central portions sooner or later become fibrotic and degenerate a fact clinically shown by the almost invariable ulceration which occurs in primary growths and by the umbilication found in secondary deposits in the liver. The process of repair tends to spread from the centre of the mass to its circumference and its ultimate outcome unless the death of the patient intervenes, is the replacement of the mass of cancer cells by a fibrous scar. Thus in chronic cases the older secondary deposits may be reduced to fibroid masses in which no epithelium can be detected. But the fibrosis and cure of the older deposits does not interfere with the process of dissemination nor delay the fatal event.

Degeneration in carcinoma.—The improvised vascular arrangements of a carcinoma frequently prove insufficient to meet the needs of the rapidly growing cell masses which fill the meshes of the stroma. Since these masses are themselves avascular there comes a time when the central cells of each alveolus, cut off from their base of supply degenerate and die. They may necrose or liquefy or change into colloid material. In some cancers these changes are only recognizable by the microscope in others, large visible areas of the tumour are affected.

Necrotic changes.—The greyish appearance which most carcinomas present on section is probably due to early necrotic changes. In more marked instances, areas of necrotic material are seen as greyish dots upon the cut surface and exude as plugs resembling sebum when the tumour is compressed. Microscopically necrotic cells fail to stain and present a granular homogeneous appearance. Here and there cell outlines may still be recognizable.

Liquefaction.—In some carcinomas each fully developed alveolus presents histologically a central cystic cavity often containing many leucocytes. Occasionally larger cysts containing clear serous fluid may be formed.

Colloid degeneration.—Colloid is a material closely allied to mucus, formed by the degeneration of the epithelium of a carcinoma. At first the stroma does not share this change but remains unaltered, enclosing spaces filled with clear jelly-like colloid material. In naked eye specimens, unaltered vessels and areas of tissue which have escaped degeneration may be seen embedded in a translucent mass of colloid. Colloid degeneration can usually only be diagnosed when the breast is cut across, and it has little clinical importance. In the specimens I have seen, the cancer has been usually rather movable and of slow growth, and the patient beyond middle age. The signs dependent upon contraction such as retraction of the nipple are usually absent

Calcareous degeneration has been recorded in the more fibroid forms of carcinoma.

Pathological classification of the signs of breast cancer.—The signs of breast cancer may be divided into classes:—

A. Those dependent upon the presence of the primary growth, and upon its infiltrative tendencies (fixity of the tumour in the breast, adhesion to skin and fascia).

B. Those dependent upon permeation and subsequent fibrosis of the lymphatics of the surrounding districts (dimpling of the skin, shrinking of the breast, elevation, deviation and retraction of the nipple).

C. Those dependent upon lymphatic obstruction (orange-rind skin, brawny arm, serous effusions).

D. Those dependent upon fibrosis and failure of nutrition in the central parts of the older deposits (ulceration of primary growth, ulceration or umbilication of the older secondary deposits).

E. Those dependent upon the formation of satellite or metastatic nodules:—

1. In the lymphatic glands, from lymphatic embolism.
2. In continuity with the primary growth, as terminal outcrops of long lines of lymphatic permeation.
3. In the viscera and serous membranes, from invasion of the serous cavities and subsequent transcoelomic implantation.
4. Those resulting from blood embolism.

Symptoms and signs.—It is unfortunate that in the earliest stage of breast cancer the signs are equivocal. Most of the classical signs are not produced by the growth itself, but by the fibrotic processes which are the reaction of the organism to the invading epithelium. Thus they are only available when the disease has already made a certain amount of progress. A patient with cancer may appear well nourished and in excellent general health. The so-called cancerous cachexia is a late sign, often produced by septic absorption from an ulcerated primary growth, or due to the habitual use of morphia.

First sign noticed by the patient.—In four fifths of the cases of mammary cancer the patient is led to seek advice because she finds a lump in the breast. In a few of these cases an occasional sharp twinge of pain has led to the detection of the lump, but as a rule pain and discomfort have been conspicuous by their absence. It is rare to find a cancer in a patient whose only complaint is of mammary pain. If the patient comes complaining of severe pain and a cancer is found, the growth is usually so far advanced as to be inoperable.

The patient may have recognized and concealed its existence for a long period perhaps for years, or if exceptionally unobservant she may not have noticed the lump Occasionally a lump in the axilla may be noticed by the patient before she detects anything wrong with the breast Discharge or bleeding from the nipple retraction of the nipple discoloration or puckering of the skin contraction or ulceration of the breast swelling of the arm pain in the spine, hip, or abdomen fracture of the femur an abdominal swelling, or signs of paraplegia—each of these conditions may be exceptionally the reason assigned by the patient for seeking advice. Many of these signs imply an advanced degree of dissemination so that the disease is hopeless when first seen The causes of this regrettable fact are feelings of delicacy dread of operation, and the insidious and painless course of the disease in its earlier stages. Medical men should lose no opportunity of teaching the public that early cancer is painless.

The signs of breast cancer will now be separately described one by one, in the order of their appearance The order is, however far from being constant.

Presence of a lump in the breast.—The primary growth usually forms a definite localized lump in the breast characteristically angle, of stony hardness, palpable with the flat hand, and fixed in the substance of the breast. In the early stage the small lump may be mobile and indistinguishable from an innocent tumour and all other signs of carcinoma may be absent. It is the surgeon's ideal to detect and remove the carcinoma in this stage and in all such doubtful cases the diagnosis should be completed without delay by an exploratory operation, especially if the patient is over 30

Deviation of the axis of the nipple.—For several years past I have been teaching the importance of this sign, which may precede retraction of the nipple and adhesion of the growth to skin and fascia. So far as I know it has not hitherto been described. The normal direction of the nipple is forwards downwards, and slightly outwards The axis of the nipple on the affected side is often deviated slightly or obviously towards the growth. No doubt the growth exerts a predominant pull upon the duct of the lobe in which the carcinoma first originates, and this is transmitted to the nipple. Consequently the long axis of the nipple tends to orientate towards the spot where the growth is situated. In order to detect slight degrees of deviation the patient must be placed at attention before the observer with the shoulders level and the direction of the two nipples must be carefully compared. (Fig. 273.) In early cases a definite slight deviation may be of decisive value in diagnosis. It must, however be remembered that any local fibrotic process in the breast is a possible cause of deviation.

Dimpling or retraction of the skin—This is one of the earliest signs of the carcinomatous nature of a small lump in the breast, and perhaps the most valuable. Dimpling is sometimes obvious to the eye (Fig 274) but careful manipulation and close observation are



Fig 273 — Deviation of the nipple towards the growth in mammary carcinoma.

necessary to appreciate the slighter degrees which are of great value and significance. The finger and thumb placed firmly upon the skin on opposite sides of the growth are to be slowly approximated. In carcinoma the convex fold of skin which is thrown up by this manœuvre presents upon its summit a slight and very shallow car

cular depression or a definite fold may fail to make its appearance and may be replaced by a number of ill-defined wrinkles.

Another method of demonstrating retraction is to push the whole breast in the direction of the area of skin to be tested. Owing to its attachments to the underlying tumour a local depression appears upon this area of skin

Adhesion of the skin—In the earlier stages of dimpling the skin still moves over the subjacent growth but later actual adhesion becomes manifest over the centre of the growth The pig skin or orange-rind appearance is now usually seen (see Fig 27I and p 68)

Adhesion to the pectoral fascia—Early cancerous growths move freely with the breast over the subjacent pectoral fascia but in a comparatively early stage especially if the growth is deeply situated in the breast, signs of fixation of the growth to the fascia become manifest. Careful attention to detail is necessary to demonstrate this sign. Either by the patient's voluntary contraction of the great pectoral or better by passively elevating the arm the fibres of this muscle are made taut. The growth is grasped in the hand and is moved to and fro in a direction parallel to the fibres of the muscle. Partial or complete fixation may thus be detected. Movement at right angles to the fibres is, of course present even when the growth is completely fixed to the muscle. If movement at right angles to the fibres is absent, the growth must be adherent not only to the pectoralis but also to the ribs and intercostal muscles and is consequently inoperable Deep growths become fixed to the muscle before adhesion to the skin is evident, while in superficial ones the reverse is the case.

Local flattening of the contour of the breast—Lenthal Cheatle has drawn attention to local flattening of the curved contours of the breast when the organ is viewed in profile as a sign of carcinoma.

Enlargement of the axillary glands.—This sign is often present by the time the patient seeks advice The prognosis is more favourable in cases where the cancer has not yet affected the glands. The glands on the same side as the tumour become unduly palpable hard and inelastic A little later they are definitely enlarged, hard, and mobile, but not tender Only in inoperable cases do they become fixed to the skin or to the thoracic wall. To examine the axilla the arm is slightly abducted, and the fingers, made into a cone are pressed upwards as high as possible along the outer wall of the axilla The palmar surfaces are then pressed against the inner wall, and are slowly drawn downwards, still firmly pressed against it If enlarged glands are present they will be felt to slip past the descending finger-tips.

Meantime the pectorals must be relaxed, the patient allowing the arm to hang loosely by her side.

Retraction and elevation of the nipple.—Retraction of the nipple occurs in one case out of four and when present usually indicates proximity of the primary growth to the nipple. The nipple is first flattened and then indrawn so that a conical depression replaces an elevation (Fig 271) The absence of retraction (Fig. 274) possesses no significance unless the growth is near the nipple, nor is its presence significant unless the nipple has previously been normal

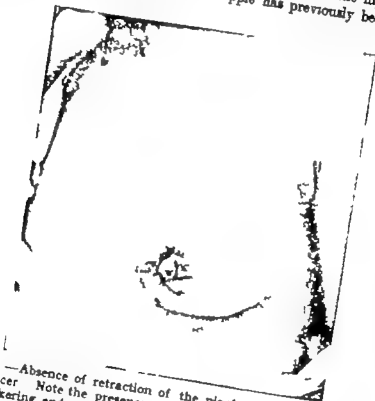


Fig 274 —Absence of retraction of the nipple in advanced breast cancer Note the presence of *peau d orange* and of extensive puckering and adhesion of the skin

In cases of atrophic scirrhus retraction of the nipple may precede the appearance of a tumour and may be the earliest change noted.

The whole breast is often drawn up towards the pectoral fascia, so that the nipple is situated on a higher level than that of the sound side This sign is a consequence of extensive perilymphatic fibrosis in the lymphatics of the breast If the growth is in the lower hemisphere the nipple may be on a lower level than usual the rule being that the nipple is displaced in the direction of the growth. In a late inoperable case of cancer of the upper and outer quadrant I have

seen the nipple displaced as much as 1½ in upwards and outwards from its normal position.

The foregoing signs may all be present in cases which are still favourable ones for operation. Those now to be described indicate that the case although perhaps still suitable for operation is an unfavourable one.

Shrinkage of the breast.—The whole breast in fibrotic growths becomes flattened and smaller than its fellow owing to the conversion of *its permeated* lymphatic vessels into a network of threads of fibrous tissue.



Fig. 276.—Case of true primary carcinoma of *each breast. The carcinoma on the patient's* right side developed twelve years after the removal of a carcinoma of the left breast.

Ulceration of the growth.—Adhesion of the skin is soon followed by discoloration, infiltration and ulceration. The ulcer has a sloughy irregular base and thickened rampart-like edges and the skin around it is puckered and indrawn. On the average, ulceration begins two and a half years from the time when the disease is first noticed. Unless the ulcer is kept aseptic by local applications it gives rise to a thin offensive discharge, sloughs form upon its surface, and serious hæmorrhage may occur. Many cancers are inoperable by the time ulceration begins but this is by no means invariably the case.

Pain in the breast.—*It is an unfortunate fact that, as in cancer*

generally pain is not an early symptom of cancer of the breast. As a rule the onset of serious pain coincides with the appearance of ulceration, but in rare cases pain may be absent almost throughout. It is usually described as pricking, throbbing, or stabbing in character The really severe pains of breast cancer occur in the inoperable stages and are then associated either with supraclavicular deposits pressing upon the brachial plexus, with lymphatic oedema of the arm, or with spinal deposits or other deposits in the bones.

Nodular invasion of the surrounding skin is a very unfavourable sign and if the nodules extend more than [illegible] in. from the primary growth the case should be looked upon as inoperable, for the area of fascial permeation will be too large for removal.

Enlargement of the supraclavicular glands is regarded by some authorities as placing a case in the inoperable category But if the glands are still mobile operation should in my opinion be advised.

The conditions which render a case of breast cancer inoperable are detailed at p 92

Diagnosis.—It is desirable that breast cancer should be operated upon before the signs of adhesion and contraction have manifested themselves—that is to say before the disease is clinically recognisable. This object can only be attained by exploring all doubtful tumours of the breast occurring in patients over 30 years of age.

The conditions which most closely simulate breast cancer are chronic mastitis, a deep cyst (especially if surrounded by an area of chronic mastitis) a fibro-adenoma situated in an area of chronic mastitis, a gumma of the breast, and tuberculosis.

The diagnosis between *chronic mastitis* and cancer may here be summed up in tabular form —

Chronic Mastitis	Carcinoma
A mobile induration uniformly and finely granular only vaguely palpable with the flat hand.	A definite lump fixed in the breast and easily palpable with the flat hand.
Indurations often multiple.	A single lump.
Indurations sector-shaped, mapping out the limits of one or more lobes of the breast.	The lump is more or less rounded, and does not respect the anatomical boundaries which separate adjoining lobes.
Indurated areas often tender and may be the seat of pain.	Lump neither painful nor tender.
The indurated areas do not adhere to skin or to fascia.	Lump usually (but not necessarily) shows signs of adhesion to skin or fascia, or both.
Axillary glands only slightly enlarged, often distinctly tender, not hard.	Axillary glands often (but not necessarily) enlarged, hard and not tender
Nipple not retracted.	Nipple may be retracted.
Skin normal.	Orange-rind skin may be seen.

Diagnosis is however complicated by the fact that a carcinoma may arise in an area of chronic mastitis. A local lump in the midst of a sector-shaped area of granular induration may be a cyst a fibro-adenoma or an early carcinoma. Multiple rounded and movable lumps will probably prove to be *cysts* a single and fixed one is often a carcinoma and imperatively demands exploration Only in cases where the indurations are vague sector-shaped, and uniformly and finely granular can a carcinoma be excluded with certainty In the large class of doubtful cases, experience alone can decide and less harm is done by exploring unnecessarily than by awaiting the full development of a carcinoma. Nevertheless routine operations in chronic mastitis are much to be deprecated.

A cyst or a chronic abscess deeply situated in the breast of a stout patient may simulate a carcinoma most closely especially if surrounded by chronic mastitis. It is exceptional to obtain fluctuation in a deep cyst. The absence of enlarged axillary glands and of adhesion to skin or fascia while suggesting that the tumour may be a cyst, does not exclude carcinoma. It is true that the puncture of the tumour by a trocar and cannula will settle whether a cyst is present but the surgeon's anxiety is merely transferred from the tumour to the surrounding breast tissue, since a carcinoma not infrequently arises in the breast tissue near a cyst. In the absence of unequivocal signs of cancer certainty can only be reached by exploration and histological examination.

The remarks made respecting a deep cyst apply also to a *fibro-adenoma* deeply situated and surrounded by an area of chronic mastitis which partially fixes it in the breast The diagnosis from cancer then becomes impossible and exploration is imperative Signs of contraction and adhesion are absent. Puncture with a trocar shows that the tumour is solid. All the means of diagnosis save actual exploration, fail to exclude carcinoma.

Gummatous and *tuberculous mastitis* which in their early stages simulate ordinary chronic mastitis, may later produce one or more indurated fixed lumps in the breast Adhesion to skin and fascia may occur and orange rind skin may be present Moreover in tuberculous and even sometimes in gummatous mastitis the axillary glands may be enlarged, hard, and not tender At this period the resemblance to carcinoma is very close Usually however in syphilis a careful search will detect tertiary lesions other than those in the breast and the rapid effect of treatment with iodide will clear up all doubts. Tuberculosis usually occurs in younger people than does carcinoma but sometimes the diagnosis is impossible before operation. In the later stages of both gumma and tuberculosis the diagnostic feature is a central area of softening in the midst of the indurated mass, and still

later the discoloration of the skin which heralds the bursting of an abscess.

Fibrotic changes in the breast resulting from a former abscess may be accompanied by some of the signs of cancer and especially by adhesion of the skin and shrinkage of the affected breast The history of suppuration, the presence of a scar upon the skin and the absence of an underlying tumour will suffice to prevent a mistake.

In the rare cases in which a *simple tumour* of the breast penetrates the skin (fungating cystic adenoma, fungating duct papilloma) malig nant disease is closely simulated. Microscopical examination of a large piece of the fungating tissue is the best solution of the difficulty In fungating simple tumours it may be possible to pass a probe some distance within the cystic cavity

The diagnosis between a hard cancer and a *sarcoma* is easy owing to the absence in sarcoma of the signs dependent upon contraction, and the large size softness, and rapid growth of the tumour But a soft cancer and a sarcoma may be quite indistinguishable save on microscopical examination In sarcoma, however the axillary glands are only exceptionally infected.

Prognosis.—The prognosis in breast cancer is difficult The questions requiring answer are mainly two If the growth runs its natural course, how long has the patient to live? After operation, what is the chance that the growth will not return?

Upon the first point very little that is helpful can be said, and the widest experience is liable to err If the growth is of recent and rapid development, and the patient young, life will probably terminate within a few months. In fibroid cancers of slow development the expectation of life is two to four years. But a cancer may remain active for forty years without killing its possessor as in a case which I have seen.

A prognosis of non recurrence after operation can be given with fair confidence if the growth has not acquired adhesions to skin or fascia, nor caused axillary enlargement, always provided that a com plete operation is performed. These are the cases detected by ex ploratory operation. In cases where diagnosis is possible without exploration the chances are in favour of recurrence and it is best to state that time alone will settle the question. In cases still operable but presenting advanced symptoms, such as ulceration, operation should not be pressed, and the probability of internal recurrence should be mentioned. But apparently advanced cases sometimes do well, and in cases which seem early some disappointments will nevertheless occur

The percentage of patients who are permanently cured by opera tion has steadily increased of late years as operative methods have

improved Future advances depend upon the earlier recognition of the disease increasing knowledge of its pathology the abandonment of restricted or badly planned (though extensive) operations, and upon advances in radiological treatment

Halsted's results show that when the modern complete operation is performed before the axillary glands have become involved, two out of three patients are permanently cured while when the axillary glands are already infected at the time of operation, three out of four patients ultimately die of their disease. In a personal series of cases including a few cases inoperable by rigid standards 48 per cent. were free from recurrence at the end of three years

At least 20 per cent of patients who survive the operation three years die of later recurrence.

Unusual varieties of breast cancer.—Breast cancer is so variable in its manifestations that it is impossible to furnish a description which suits all cases. Certain special forms need separate consideration.

Medullary or soft carcinoma.—The hardness of a typical scirrhus is due to the fibrotic processes which are associated with it. If the proliferative activity of the cancerous epithelium out strips these defensive fibrotic processes, a large lobulated growth of relatively soft consistence is rapidly formed. The axillary glands enlarge and may soon attain the size of chestnuts, and the skin becomes extensively adherent and assumes the orange rind appearance. Jlceration supervenes and a fungating mass of malignant tissue rotrudes, from which large sloughs may separate. Sepsis, repeated eeding, and dissemination lead rapidly to death. To growths of s character the name medullary carcinoma was formerly applied, indicating their soft marrowy consistence. They occur more ecially in young women, and are of bad prognosis. Many of cases which clinically present the features to be described as racteristic of sarcoma are nevertheless found on microscopical nination to be carcinomas of this type.

Atrophic scirrhus.—Cases are not uncommon in which the struggle between the cancer and the individual is prolonged and doubtful. Such appears to be the true explanation of cases of atrophic scirrhus. In the most marked form of atrophic scirrhus a puckered scar to which the skin may be attached, slowly forms in the breast. The whole breast becomes somewhat shrunken and the nipple indrawn, but no definite tumour makes its appearance.

The disease in this form is usually painless, and the patient's attention is attracted only by local puckering and adhesion of the skin. Frequently she attaches no importance to these signs and it is only when she consults a medical man for some other condition

that the lesion of the breast is discovered. It may persist for many years without obvious change until the patient dies of some other disease but if she survives long enough it is likely that local malignant ulceration or dissemination resulting from permeation will terminate the case.

In less extreme cases of atrophic scirrhus the primary focus, after attaining the dimensions of a definite tumour subsequently shrinks and disappears, or leaves only a mass of dense fibrous tissue, in the central portion of which no trace of malignant epithelium can be found. The breast is reduced to a small fibrous relic resembling the male breast Complete fibrosis of the primary growth does not necessarily or usually prevent dissemination which, however in these cases is very slow attacking rather the skin subcutaneous tissue, and bones than the internal organs.

Some authorities state that cases of atrophic scirrhus should not be operated upon—an opinion which probably dates from the time when nearly every operation upon breast cancer was an incomplete one. If any part of the growth is left behind, it is quite likely that it may be stimulated to vigorous activity by the operative interference. But there is now a reasonable hope of complete operative eradication of the disease and even if this end is not attained, the inhibitory action of X rays and radium may be called in to assist the effect of the operation I hold therefore, that cases of atrophic scirrhus, except in very old or very feeble patients, should be operated upon. No one can tell when an atrophic scirrhus may blossom forth into a carcinoma with active powers of dissemination

In deciding whether to operate upon an atrophic scirrhus an especially careful general examination must be made, for the growth may have been present for years and dissemination may have made progress before the mammary signs led the patient to seek advice. Sometimes a spontaneous fracture of the femur a deposit in the spine, or the presence of an abdominal, pelvic or hepatic tumour may be the first obvious sign of an atrophic carcinoma of the breast, or of a tumour of some size embedded in a voluminous mamma If a tumour is detected in a woman of middle age whatever its situation the breasts must be carefully examined for signs of carcinoma.

Peripheral carcinoma.—A carcinoma of the breast may commence in some outlying lobule apparently quite separate from the main body of the gland. The possibility that these outlying growths may begin in a supernumerary mamma must not be overlooked

The prognosis of peripheral carcinoma is worse than that of the more central variety A peripheral growth is likely to be separated from the pleural cavity by a relatively thin protective layer of muscles,

as compared, for instance with a growth which overlies the great pectoral. Consequently the growth early becomes adherent to the chest wall and therefore inoperable Moreover operations for peripheral carcinoma in the past have nearly always violated the rule deduced by the writer from the permeation theory that the primary growth must form the centre of the field of operation and of the



Fig. 276.—Ulcerated scirrhous carcinoma situated in the angle between the two breasts, in the middle line.

area of tissue removed. The observance of this rule is of cardinal importance in these outlying growths.

The case of peripheral scirrhus represented in Fig. 276 was that of a female aged about 65. Situated accurately in the middle line, just above the ensiform cartilage, at the point to which the lower contours of the mammæ converge, was an irregular ulcer about an inch in average diameter with a sloughy base, and hard, irregular, raised edges surrounded by sub-

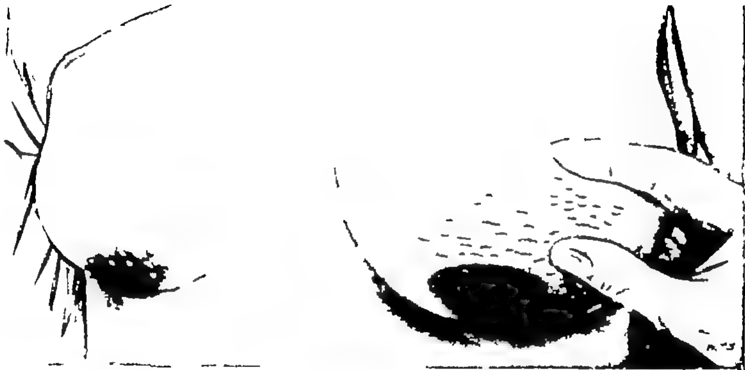
cutaneous induration. The whole mass, which could be covered by a florin, was firmly adherent to the underlying sternum, which, however was not exposed in the floor of the ulcer The situation of the lesion suggested a gumma. This, however was excluded by the absence of suppuration, by the fact that bone was not exposed, by the absence of a syphilitic history and above all by the presence in *both* axillæ of hard enlarged glands of the type familiar in carcinoma. The median situation of the growth had led to simultaneous invasion of the axillary glands on both sides.

Acute cancer of the breast (*mastitis carcinomatosa brawny cancer*) —The most acute form of breast cancer is found only in women below middle age and usually of florid aspect. It is accompanied by an erythematous blush of the skin over the tumour (Plate 84) It generally develops during lactation though it may also occur in virgins. All the signs of inflammation are present. The whole breast is swollen and prominent The skin is red and hot, and may be swollen and œdematous, sometimes presenting the typical *peau d'orange* appearance. The nipple may be either retracted, or swollen and œdematous. A large tumour rapidly involves the entire breast and becomes firmly fixed to skin and fascia. Within a few weeks the chest wall may present the appearance of advanced cancer *en cuirasse* The thickened and rigid skin, now immobile upon the chest wall is covered with cancerous bosses. General dissemination rapidly takes place, and within a period of from six weeks to three months after the onset of the disease the patient is dead. Operation in these cases is useless. The cutaneous œdema may lead to the erroneous diagnosis of mastitis or mammary abscess.

In some cases of acute cancer swollen white cords, radiating from the nipple may be seen upon the surface of the skin It is usually believed that they are the larger superficial lymphatics distended by lymph. The intermediate skin is swollen from lymphatic œdema

Diagnosis—Acute cancer of the breast has often been mistaken for mammary abscess, and has been incised under this impression Although œdema of the skin may be present over a pointing abscess, it is rarely extensive. In acute cancer the lymphatic œdema of the skin is coextensive with the breast, and moreover the affected area is uniformly and firmly adherent to the underlying breast and often indurated from commencing cancerous infiltration. The breast, too is firmly fixed to the chest wall, which is not the case in acute mastitis.

Impalpable carcinoma of the breast —It is an important fact that in rare cases a carcinoma may be present in the breast for a long period and even for many years, without giving rise to any palpable tumour Sometimes in these cases enlargement of the axillary glands and the later signs of dissemination remain absent and the description "atrophic scirrhus is appropriate (see p 83) In other cases,



Acute carcinoma of the breast, with a six weeks history in a woman of 45. There was a mass of large but still mobile glands in the axilla. The case was unassociated with pregnancy or lactation *P'au d'orange* an erythematous blush and extensive skin-adhesion were present.

however, though the primary growth remains of microscopic size enlargement of the axillary glands occurs and the glands may even reach the size of chestnuts These cases were formerly described as primary cancer of the axillary glands In such cases if the glands are cancerous and no other primary focus can be found the breast should be removed and as in a case of which Dr Macnaughton Jones informed me thorough microscopical examination may reveal a minute



Fig. 277.—Edge of an actively infiltrating cancer of the breast under a low magnification (× 5) Note the narrow dark columns of cancer cells penetrating the interstices of the surrounding tissues. Cf Fig 278.

mammary carcinoma Halsted has met with two similar cases. The facts of impalpable carcinoma have an important bearing upon the pathology of Paget's disease of the nipple (see p. 11)

In certain cases which simulate impalpable carcinoma a primary growth originating at the axillary edge of the breast may be mistaken for an enlarged axillary gland.

Mobile carcinoma of the breast.—It is too often assumed that a carcinoma of the breast is always firmly fixed in the organ. This is indeed the case if the growth is actively infiltrating (Fig 277) But

certain exceptional carcinomas of the ordinary spheroidal type are sluggish in this respect, and they consequently acquire a fibrous capsule sometimes almost as definite as that of a fibro-adenoma. The capsule may be complete, even upon histological examination (Fig 278) and in such cases the tumour is mobile and may even be enucleated without much difficulty. Thus after removal of the tumour and still more easily before operation it may be mistaken for a fibro-adenoma. An apparent fibro-adenoma first appearing after the age of 40 is more likely than not to be a carcinoma.



Fig 278.—The edge of a mobile (non infiltrating) carcinoma of the breast under a low magnification (× 5). The growth was surrounded by a capsule of fibrous tissue almost as definite as that of a fibro-adenoma. Cf Fig 277

Although these cases are exceptional they lead to conclusions of the greatest importance. (1) In women approaching the cancer age, all rounded tumours of the breast even those which appear quite innocent should be dealt with promptly by operation. (2) All tumours of the breast after removal must be submitted to microscopical examination.

Duct cancer of the breast (*columnar celled carcinoma*).—Histologically this disease is divisible into two forms—(1) carcinoma originating in the large ducts, (2) carcinoma beginning in the small ducts. In the former variety (Fig 279) the breast is riddled with caseous

areas which are the greatly dilated ducts filled with the caseous débris of cancerous epithelium or with richly plicated papillomatous outgrowths, or with hæmorrhagic débris. Outside these spaces there is irregular cancerous infiltration of the tissue spaces of the breast. Such cases appear to originate as innocent duct papillomas which have undergone malignant degeneration (Fig. 280). The growths are of slow development and of relatively good prognosis. They are slow in becoming adherent to their surroundings and in affecting the axillary glands. They develop usually beneath the nipple and in women over middle age. Retraction of the nipple is usually absent.



Fig. 279.—Duct papilloma and duct carcinoma in the same microscopic field. A large duct crosses the field vertically. From its right wall a small duct papilloma projects into the lumen. From its left wall is seen an outgrowth of columnar-celled carcinoma which is infiltrating the surrounding tissues. × 20.

The other variety of duct carcinoma—that originating in the small ducts—cannot be clinically differentiated from the ordinary spheroidal-celled or acinous



Fig. 280.—Cystic duct papilloma passing into duct carcinoma. The papillomatous growths beneath the nipple are commencing to infiltrate the surrounding tissues. Note the absence of retraction of the nipple.

(From a case under the Author's care. Specimen preserved in the Middlesex Hospital Museum.)

carcinoma. The histological picture is that of small, irregularly proliferating spaces lined with columnar cells. These spaces infiltrate the breast tissue and convert the regular pattern of its lobular structure into a confused and irregular maze. The picture presented recalls that of a columnar-celled adeno-carcinoma of the intestine (Fig. 267.)

Not infrequently this variety of duct cancer is accompanied by cancerous changes in the acini also and it may be difficult to say whether the growth is a columnar or a spheroidal-celled carcinoma. The truth is, as stated earlier, that probably nearly all the spheroidal-celled carcinomas are really duct carcinomas in which the epithelium has lost its original columnar character.

Clinical history.—In cases of carcinoma of the breast if there is a history of serous discharge from the nipple of some years standing, the disease will almost certainly prove to be a duct cancer originating in the larger ducts. It is essential to recognize clearly that the absence of signs of contraction and adhesion is frequent in the presence of a carcinoma of this variety.

Carcinoma of the male breast.—The male breast is liable to most of the diseases which affect the female breast. Chronic mastitis, adenoma, sarcoma, duct papilloma, and other conditions occur as rarities in the male. But the only disease whose comparative frequency gives it importance is carcinoma, which may be of the spheroidal or the columnar or the squamous-celled variety. The disease appears later in men than in women and in nine cases collected by C. R. Keyser the average age was 61 years. J. R. Lunn has recorded a case of duct cancer in a man of 91 and this appears to be the oldest age on record in this connexion. Of 100 breast cancers, only one occurs in a male. A history of definite injury is common. The disease begins as a button-like induration, at first mobile, situated beneath or near the nipple. Later adhesion to skin or fascia develops, the axillary glands become enlarged, and, by the time the growth has reached the size of a walnut, ulceration sets in. In more than half the cases the tumour is ulcerated when the surgeon first sees it. This may be accounted for by the absence of pain prior to ulceration, and the freedom of men from dread of this particular disease.

In all its essential features, cancer of the male breast is identical with the same disease in the female. It requires treatment on the same lines and by an equally free operation. There can be little doubt however that operations for cancer of the male breast have been unduly restricted, the small size of the breast and of the primary lesion seeming to invite a limited excision. For this reason, and because the growth is necessarily from the beginning in close proximity to the pectoral fascia, the results of operation in men have been unsatisfactory.

Exploratory incision prior to operation — Some surgeons believe it to be dangerous to incise a doubtful carcinoma before removing it on account of the danger of liberating cancer cells which may become implanted upon the field of operation. The risk is a very small one if precautions are taken but of course, a carcinoma should not be incised if the diagnosis is certain In case of doubt a small incision is made down upon the growth and its enucleation is attempted. If the effort is unsuccessful an incision is made into but not through the central portion of the growth. If after inspection or removal of a small piece, malignancy is diagnosed, the wound is stuffed with a small swab, the deeper portion of which has been dipped in pure phenol and the small wound is tightly sewn up over the swab The instruments, towels, and gloves so far used are discarded, and the operation for carcinoma is begun

Naked-eye characters of an incised carcinoma.—The tumour may creak under the knife, but more commonly cuts like a piece of potato. It cannot be shelled out of its bed, save in rare instances, and it exhibits radiating fibrous processes firmly anchored amid the surrounding fat. In colour it is greyish or pinkish grey in this respect and in its consistency contrasting with the leathery toughness and yellowish tinge of chronic mastitis, and with the whitish enucleable fibro-adenoma Upon the greyish surface of a carcinoma yellow dots representing areas of necrosis are frequently visible. An opaque fluid (cancer juice) can be scraped from the cut surface, which becomes characteristically concave as soon as the section is made.

Rapid microscopical examination.—If naked-eye inspection does not resolve doubts as to the nature of the tumour it is, I think, better as a general rule to sew up the wound and defer the operation for a few days until a paraffin section of the excised piece has been made. But if a skilled pathologist is available an immediate examination should be made in the theatre by one of the rapid freezing methods, perhaps the best of which is Leitch's. The method is not to be relied upon unless the observer has had long practice in the examination of frozen sections—a fact acknowledged by its pioneer Ernest H. Shaw Few pathologists possess the necessary experience, and for this reason the method though ideal is at present not generally applicable.

Principles of the operation for breast cancer—While many technical variations are possible in the operation for breast cancer especially as regards the planning of the skin incision certain general principles determined by the mode of spread of the disease must be held inviolable. The aim of the operation is not merely to amputate the breast, though this is in all cases necessary but

to remove intact the permeated area of the lymph-vascular system which surrounds the primary growth, in one piece with the lymphatic glands which may have been embolically invaded along the trunk lymphatics of the permeated area. To attain this object certain points must be specially borne in mind.

1 *The area of the operation must be concentric with the growth* Only when the growth itself is central must the nipple be taken as the central point of the area of skin and subjacent tissue to be ablated.

2. The area of tissue removed must approximate to a circle in shape, in view of the centrifugal spread of permeation.

3. Since permeation spreads primarily by way of the deep fascial lymphatic plexus, the ablation of tissue must be most extensive in the plane of the deep fascia and the area of fascia removed must be a circle.

4 Smaller circular areas of skin and of muscle also require removal on account of the secondary invasion of these layers from the permeated fascial plexus.

5 The skin incision subject to the preceding condition, should afford convenient access, and should not be so placed that the scar will lie along the anterior axillary fold, since in this situation it will tend to bind the arm to the side.

It may here be repeated that the very extensive ablation of skin carried out by some surgeons, based upon erroneous ideas concerning dissemination is not found in practice to improve the results of the operation.

6 During the operation precautions should be taken against the possibility of epigastric invasion of the abdomen.

Choice of cases for operation—Now that the immediate risk of operation is under 2 per cent., it is unfair to refuse operation unless the case is evidently hopeless. Apparently advanced cases sometimes do well and even if internal recurrence takes place, the patient may be saved the distress of an ulcerated growth. In early cases operation should be urged, in later cases offered.

Except in rare instances as a palliative measure for the removal of a foul ulcerated mass, operation should be refused—

(a) When the primary growth has become attached to the bony thorax.

(b) In the presence of cancer *en cuirasse*, or of subcutaneous nodules or skin infiltration situated more than 2 in. from the primary growth.

(c) If there is a fixed mass of growth in the axilla, evidently adherent to its walls.

(d) If there is marked œdema of the arm.

(e) If the supraclavicular glands are enlarged, hard and fixed
(f) If there is evidence of visceral or bone metastases.
(g) If there is incurable constitutional disease—tuberculosis or diabetes, for example—likely to be fatal in a few years at most or to lead to a postoperative fatality
(h) In the acute forms of carcinoma.

Examination prior to operation—Remember to examine the spine for angular curvature the epigastric parietes for nodules and the pelvis for deposits in the ovaries and in Douglas's pouch, in addition to the usual preoperative medical examination.

Preparation of the patient.—Since massage of the mammary region must tend to favour dissemination no compress should be employed. The axilla should be dry-shaved overnight and the whole field painted with iodine a few hours before operation and again upon the table.



Fig 281—Recurrence of breast carcinoma following an inadequate operation. A portion only of the breast has been removed, and the axilla has not been cleared. Recurrence has taken place in the subclavian glands, and a mass of growth is seen pushing the pectorals forward.

During the operation the arm must not be forcibly stretched upwards so as to injure the brachial plexus. The whole operative field must, as far as is possible, be covered up with relays of hot towels. The best anæsthetic is C.E. mixture, accompanied by a feeble stream of oxygen. Pure ether is inadvisable because by inducing very free hæmorrhage it may be the indirect cause of post operative shock.

Technique of the operation (Handley's method).—The **skin incision** is only just deep enough to open up the subcutaneous fat without extending through it into the neighbourhood of the deep fascia. It consists of three parts —

1 A ring incision as first practised by Mitchell Banks, 4 to 5 in.

in diameter accurately centred on the growth and surrounding it at a safe distance slightly tailing off into incision No 2 above and into No. 3 below

2. A curvilinear incision for giving access to the axilla. The axilla is opened by turning forward a flap consisting of skin and a thin layer of subcutaneous fat, whose base lies along the anterior axillary fold. The axillary incision begins at the lower edge of the great pectoral, close to its insertion It ends, also at the lower edge of the great pectoral, by joining the annular incision, No 1 It crosses the base of the axilla and marks out a shallow semilunar flap of skin, whose convexity lies in the vault of the axilla not far from the edge of the latissimus dorsi. It affords perfect access to the axilla and good drainage afterwards.

3. A linear incision coming off from the lower and inner part of the annular incision and passing downwards for about 2 in along the linea alba Its object is to give access for the removal of the deep fascia over the upper part of the abdominal wall. Without it this important step in the operation cannot be properly carried out.

Elevation of the skin flaps.—The skin-flaps are next undermined in the mid plane of the subcutaneous fat until there is exposed an area of the deeper subcutaneous fat forming a circle 10 to 12 in. in diameter with the primary growth at its centre. The exact anatomical limits of this dissection will of course vary with the situation of the growth in the breast. The assistant retracts the skin flaps as they are formed, and subsequently keeps them carefully wrapped in hot towels frequently renewed. Neglect of this precaution is likely to be followed by ulceration of the edges of the flaps.

At this period of the operation no attempt should be made to apply artery forceps to every small bleeding point. Spouting vessels in the deep surface of the skin flap should be clamped, but bleeding from the exposed surface of subcutaneous fat is sufficiently checked by the pressure of large flat swabs for nearly all the exposed vessels will again be divided at a deeper level.

Delimitation of the area of deep fascia to be removed—An annular incision marking out the 10-in. circle of deep fascia to be removed, is now carried down to the muscles through the deeper subcutaneous fat close to the base of the skin-flaps, which are meanwhile strongly retracted by the assistant.

Elevation of deep fascia from the underlying muscles—The circular area of deeper subcutaneous fat and deep fascia in which lies embedded the presumably permeated area of the fascial lymphatic plexus, is now dissected from the subjacent muscles for some distance from its circumference towards its centre, so as to form

a wide marginal fringe of the main mass, consisting of breast pectoral muscles, and axillary contents which is to be subsequently removed The fringe of deep fascia is to be raised up all round the field of operation until the knife reaches either the margin of the great pectoral muscle the margin of the axillary outlet or the edge of the breast as the case may be.

The amount of dissection required varies in different parts of the field of operation. At the upper limit of the field of operation hardly any freeing of the fascia will be required since in this region it will come away with the great pectoral when that muscle is divided below its clavicular origin Towards the middle line the fascia will usually require dissecting up from the inner margin of the opposite great pectoral and from the sternum. In doing this the perforating branches of the internal mammary artery on the side *opposite* to the growth are often divided, and must be secured The division of these branches necessarily implies also division of the lymphatics which run with them from the pectoral lymphatic plexus to the anterior mediastinal glands, and thus additional security against thoracic invasion is obtained. (The corresponding perforating branches on the same side as the growth are divided later during the detachment of the great pectoral.)

As regards the lower limit of the field of operation, it will be found that a 10-in. circle of deep fascia with the growth at its centre will usually extend well down over the epigastric region of the abdomen In this part of the field of operation the anterior layer of the rectus sheath on both sides of the middle line should be raised up and removed with the deep fascia. In order to accomplish this, the linea alba must be split from below upwards in the coronal plane. It is particularly in the epigastric region that wide and careful removal of the deep fascia is imperatively called for so as to prevent the access of cancer cells to the peritoneal cavity In this part of the field of operation numerous small blood vessels emerging from the rectus muscle will probably need attention.

Towards the outer side of the field of operation the fascia must be dissected up from over the anterior edge of the latissimus and from the serratus magnus. Higher up, especially if the growth lies in the outer portion of the breast, the fascia over the inner margin of the deltoid muscle and about the posterior margin of the axillary outlet must be raised if it falls within the circle marked out for removal although the requisite dissection is difficult and tedious.

Division of muscles.—If the growth is an early one, or is situated low down in the breast, it is probably safe to leave the uppermost fibres of the pectoralis major near the margin of the deltoid muscle With this exception the whole of the great pectoral needs removal

as Halsted first pointed out. It is split below its clavicular attachment next a finger is inserted beneath the muscle from above, so as to put its fibres on the stretch, and its chondral and sternal attachments are rapidly divided from above downwards close to their origin. The muscle is lifted from the chest and turned outwards, and the external anterior thoracic nerve and the vessels which run with it are divided where they pierce the costo-coracoid membrane

The pectoralis minor now comes into view and is best removed, except in early cases. It is divided at its costal origin.

The pectoral muscles are now cut across at their insertions respectively into the humerus and the coracoid process, and the whole mass of tissue is allowed to fall over towards the axilla

Removal of axillary contents—The costo-coracoid membrane, now freely exposed, is cautiously divided just below the clavicle, and the fat at the extreme apex of the axilla is thus brought into view It now becomes easy to reach the highest axillary glands—subclavian in the strict sense of the word—which so easily escape notice unless they are carefully looked for The axillary vein is sought for in this situation and is carefully cleared from above downwards. As this dissection proceeds, the subscapular vein and other axillary tributaries come into view and are secured and divided The subscapular nerves are exposed, isolated and preserved. The inner and posterior walls of the axilla are cleaned from above downwards, preserving the nerve of Bell, and the mass of tissues is now retained only where the lower and outer part of the breast overlies the serratus magnus The digitations of this muscle where it lies in direct contact with the deep surface of the breast, should be superficially shaved off with the knife. The whole mass of tissues is now freed and removed by the division, farther back towards the scapula, of the elevated superficial layer of the serratus magnus. A superficial layer of the digitations of the external oblique, which arise from the fifth and sixth ribs, should also be removed

The parts removed form a single circular biconvex mass with thin extensive fascial edges To its outer side a pyramidal mass of axillary fat and glands is attached. The mass shows a central circular patch of ablated skin on its superficial aspect. On its deep aspect are seen the pectorals, and portions of the serratus magnus and of the anterior layer of the rectus sheath.

Hæmostasis and drainage.—Any bleeding points which have escaped ligature or forcipressure are now attended to Two small drainage-tubes are inserted through punctures in the extreme base of the skin flaps one in the epigastric angle the other at the posterior margin of the axilla These tubes are removed at the first dressing twenty-four hours later

Sutures.—Trial is now made to secure the best coaptation of the edges of the incision. The problem varies in each case according to the situation of the growth in the breast and to the degree of laxity of the skin. The most striking indirect advantage of the operation now becomes evident. The wide removal of the deep fascia so mobilizes and frees the surrounding skin that even after the removal of a 5-in circle of integument the edges of the incision can usually be brought together without the use of tension stitches, by a single continuous suture of fine silk. Tension in the skin flaps—the principal cause of prolonged shock of pain and discomfort to the patient, of impaired circulation in the skin flaps, and of delayed union and ulceration in the sutured incision is thus entirely avoided.

Often it will be found best to bring the edges together in triradiate fashion in other cases as a sinuous line. In growths of the upper and outer quadrant some difficulty may be met with in covering the raw area, and in these cases the axillary flap of skin may be pulled inwards to assist in covering the thoracic gap.

Removal of the supraclavicular glands.—The posterior triangle should be opened up and the supraclavicular glands removed if these glands are palpably enlarged, or in any event if the subclavian glands at the apex of the axilla are cancerous, or if the primary growth is situated in the upper hemisphere of the breast. My experience as regards recurrence shows that the posterior triangle should be cleared much oftener than is at present the practice in this country and that Halsted and Rodman are right in advocating the frequent performance of this dissection.

After-treatment.—It is my practice to confine the arm to the side until the incision is healed leaving the forearm and hand free to move. Some operators prefer to fix the upper arm in an abducted position to prevent subsequent binding of the arm to the side—a danger which, in my experience, need not be feared if, after the healing of the incision, a course of massage is applied to the skin of the thorax. The abducted position tends to increase tension in the flaps, and thus to interfere with healing.

In every case as soon as the wound is healed, a prophylactic course of X-rays must be applied to the thorax, axilla, and supraclavicular region—a precaution which I believe to be imperative. Four cases only of recurrence in the skin have come under notice in my series of operations of which three were those of patients who had not undergone a prophylactic course of X rays (the percentage of my patients who escape a prophylactic X-ray course is a very small one).

After the operation for breast cancer a prolonged course of open-air treatment should be advised. If the patient will not consent to this,

she should, at any rate, live as much in the open air as possible. A sea voyage may be of advantage.

Plastic operations in cancer of the breast.—Much ingenuity has been expended by surgeons in devising plastic flaps to fill the gap left after removal of a cancer of the breast (Jackson's, Tansini's). These operations are unnecessary, for if an adequate area of the deep fascia be removed, and if ablation of the skin be not pushed to the point of unnecessary sacrifice, difficulty in bringing the flaps together is rare. It is only met with in thin women with ill-developed chests. Immediate skin-grafting by Thiersch's method is the best solution of the difficulty.

Plastic methods are not only unnecessary, they are also dangerous, for the tissues utilized to form the flap are frequently situated within the area of possible cancerous infection.

Cause of death in breast cancer.—Although dissemination is the rule, a cancer of the breast may run its course without producing secondary deposits. The disease makes slow progress until the viscera are attacked. When visceral involvement declares itself, the patient has usually but a few months to live.

The patient may die from general dissemination, from exhaustion, from septic absorption, from deposits in the brain, from pleural and pericardial effusions, from ascites, from paraplegia due to spinal deposits, and in rare cases as the direct result of bleeding from the ulcerated growth. Intercurrent diseases, especially pneumonia and erysipelas, are responsible for a certain number of deaths. The average duration of life after the appearance of the growth is stated by Campiche and Lazarus-Barlow to be about four years.

Recurrence.—In the days preceding the work in this country of Banks, Stiles, and Watson Cheyne, and in America of Gross, Meyer and Halsted, the disease in nine cases out of ten returned in or near the scar of the operation, affecting one or both flaps more or less diffusely.

At the present time, at any rate if prophylactic radiation is used after the operation, local recurrence is rare. The following table shows the site of recurrence in 26 cases taken from my private notebooks:—

Locally (2 of these cases had escaped X-ray treatment)	4
Supraclavicular	[illegible]
Intercostal	5
Peripheral fascial recurrence	2
Cerebral	1
Thoracic	4
Abdominal	1

It appears from this table that the precautions now adopted to prevent epigastric invasion are adequate, and that the circle of deep

fascia removed was sufficiently large to include the microscopic growing edge of the disease in every case but 2. It is also shown that recurrence in the axillary and subclavian glands is preventable. It would appear that in 6 cases of the 70 the seeds of the disease had already been disseminated in the internal organs at the time of the operation.

More than half the cases of recurrence come under the headings of supraclavicular and intercostal recurrence.

Intercostal recurrence.—*Pari passu* with the diminution of diffuse local recurrence there has emerged a late and peculiar form of recurrence in which nodules of growth, not at first adherent to the skin, appear at the inner ends of the upper intercostal spaces, usually the first, second or third, on the side of the operation. These nodules must arise from the anterior mediastinal glands, and they show that at the time of the original operation carcinoma cells had already reached these glands.

Supraclavicular recurrence.—The frequency at the present day of a late return of the disease in the supraclavicular glands shows similarly that often there is a microscopic infection of these glands, clinically inappreciable at the time of the operation. The first indication of supraclavicular recurrence is usually the appearance of an enlarged gland situated deeply near the subclavian artery at the lower and inner angle of the posterior triangle.

Spinal recurrence.—Spinal deposits in breast cancer cause severe neuralgic pain, often assuming the characters of girdle pain, at the level of the lesion. The pain is aggravated by movements, especially by those of a jolting character and is relieved by recumbency. There is local tenderness and prominence of the spines, and the affected segment of the spine loses its mobility. Paraplegia may follow. Usually the spine is affected by local extension from cancerous glands, or by infiltration from a pleural infection. The cervical and lower dorsal regions are most frequently attacked. Treatment is unsatisfactory. A poroplastic jacket may for a time postpone recumbency. The use of morphia should be deferred as long as possible.

Operative treatment of recurrence.—Isolated superficial nodules of recurrence can often be treated successfully by excision, but in cases of this class radiation is beginning to supersede operation. Recurrence in the supraclavicular glands, if the glands are still mobile, should be treated by a complete gland-dissection of the posterior triangle, reinforced by radiation treatment. Operations for recurrence should be preceded by an especially careful examination to exclude other deep-seated recurrences. A radiograph of the thorax should usually be taken.

Prevention of supraclavicular and intercostal recurrence.—The present results of operation would be greatly improved if

supraclavicular and intercostal recurrence could be abolished. It is possible to remove both the glands above the clavicle and those along the internal mammary artery but such a grave extension of an already large operation is undesirable.

During the past three years I have made it a routine practice to bury radium tubes in the situation of these glands at the time the breast is removed, leaving them in position for twenty four hours. One tube is placed at the lower and inner angle of the posterior triangle beneath the fascia, and one tube at the inner end of each of the first three spaces, beneath the intercostal muscles (Fig 282). Each tube should contain not less than 25 mg. of radium. It is too early as yet to say anything of the results of this procedure.

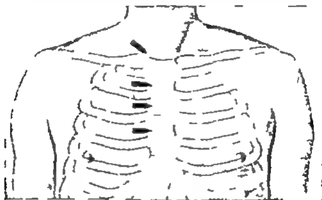


Fig 282.—Position of radium tubes.

Radiation in carcinoma.—The treatment of carcinoma of the breast by X rays and radium has not yet proved itself a substitute for operation, but has reached a secure position as an indispensable adjuvant to operative treatment. X rays and radium have distinct fields of employment. X rays are especially suitable when a large area has to be covered and when the deposits do not extend more than an inch beneath the skin. (It remains to be seen whether the more penetrating X rays recently made available are more effective.) Radium, on the contrary is only suitable for treating small localized deposits of growth. But, since radium tubes can be buried in the tissues, deep foci of growth inaccessible to X rays can be dealt with.

Use of X rays—X rays may be used as a substitute for operation in old, feeble, or constitutionally unsound patients. The most that can be hoped for is to delay the march of the disease. Pre-operative X radiation of the growth is ac ... by some authorities, but should not be allowed to delay o ... Radiation during operation has been urged, but has many ... After

the healing of the wound a postoperative prophylactic course of X rays should never be omitted It should cover a wide area, extending to the scapula, the neck and the opposite breast Two courses, each of three months, and separated by a three months interval, are advisable. Recurrence should be treated by X rays if it is inoperable, too diffuse to be treated by radium, and not very deeply situated

Use of radium—The prophylactic use of radium during operation has been already described As a substitute for operation in a feeble patient, buried radium may be used to reinforce the action of X rays from the surface. It is in the treatment of small localized recurrences after operation that radium finds its happiest employment, and here, in my experience, it may even complete the cure of the disease. Even in such cases as ulcerated sternal deposit, radium may give the patient several additional years of activity and comparative freedom from pain postponing invalidism until intrathoracic deposits rapidly and often painlessly end the patient's life.

Treatment of advanced breast cancer—In cases where neither operation nor radiation can be recommended, all that remains is to make the patient as comfortable as possible and to endeavour to delay the march of the disease.

Open-air treatment—I have a strong impression that the disease runs a slower course in rural than in urban patients. Moreover I have observed that a sea voyage or a stay in the country sometimes retards its progress. The resemblance of the reactive or defensive processes in cancer to those seen in tuberculosis also strongly suggests the advisability of systematic open-air treatment in the more chronic cases of inoperable cancer Experience has convinced me of its value in checking the disease.

Drug treatment.—It was formerly usual to resort to morphia as soon as pain began to interfere with sleep. This practice is much to be deprecated, for the drug soon impairs the patient's personality and interferes with the action of the stomach, bowels, and kidneys, thus accentuating the toxic or cachectic condition which may be already present. Phenacetin at night, alone or combined with caffeine will generally give sufficient relief to allow of sleep Aspirin may be tried, but my own experience of it is disappointing Later on, heroin may also be used The aim should be to defer the use of morphia until the last stage of the disease. The drug will then exert its maximum effect, unimpeded by the toleration of habit at the time when it is most urgently needed.

Treatment of lymphatic œdema of the arm.—In slight and early cases, where the œdema still pits on pressure, habitual elevation of the arm, either during the night or for several hours daily will afford relief for some time Later on, in properly selected cases,

the writer's operation of lymphangioplasty affords great relief at a very small risk but it is, of course, a palliative only and does not delay the progress of the growth. In suitable cases the following benefits may be expected (a) Complete relief from pain within twenty four hours unless the pain is partially due to some cause, such as nerve pressure independent of the œdema (b) A great and rapid fall in the tissue tension of the whole area drained by the threads, so that the arm becomes soft and flabby (c) Rapid subsidence of the swelling, commencing immediately in the hand, and extending to the forearm within twenty four hours. At first the upper arm is unaffected, or its diameters may even slightly increase but within a week or two the diameters of the upper arm also are markedly lessened. The subsidence is usually permanent, unless and until pleural effusion supervenes to interfere with drainage. These effects are at first dependent upon the adoption of proper postural after treatment, but after a few months, elevation of the arm may be entirely abandoned without marked increase of swelling (d) Return of power to the paralysed arm, provided that the paralysis is of recent date. Thus, one of my patients, whose arm was totally paralysed, was subsequently able to write me a letter (e) An improvement in the general condition dependent partly upon relief from pain and insomnia and partly upon the abandonment of sedatives.

Technique of lymphangioplasty for brawny arm.—The special materials necessary are a set of suitable probes, lymphangioplasty forceps with jaws specially designed to take a firm grip of either end of the probe and a supply of No 12 tubular silk. The tissues of the arm are drained by two long U-shaped lines of silk, each line composed of two threads of No 12 tubular silk (Fig 283) One of these lines drains the front of the arm, the other the back. The bend of each U lies immediately above the wrist and its two lines occupy respectively the radial and ulnar side of the limb Thus, along the whole length of the limb are found four double lines of silk, spaced out round the limb as nearly as possible at quadrant intervals. Towards the shoulder the lines of silk on the flexor aspect curve outwards around the deltoid muscle, and converge to meet the ascending threads from the posterior aspect at a point near the posterior border of the deltoid. From this point the silk threads again radiate in the subcutaneous tissue of the back, terminating by free ends in the subcutaneous tissues of the scapular region. It is perhaps still better to lead some of them to the scapular region of the opposite side, and others to the lumbar region of the same side if there is any sign of the œdema extending from the arm to the trunk.

The operation is done as follows Take a double line of silk, rather

more than twice as long as the arm and mark its mid point by clipping on it a pair of artery forceps. Wrap up one half of its length in gauze. Thread the two ends of the other half through the eye of a long probe. Make an incision ½ in long through the skin at the middle of the front of the forearm, just above the wrist joint. Thrust the probe in the desired line upwards in the subcutaneous tissues well away from the skin towards the region of the elbow as high as is convenient and cut down upon its point. Withdraw the probe through the incision

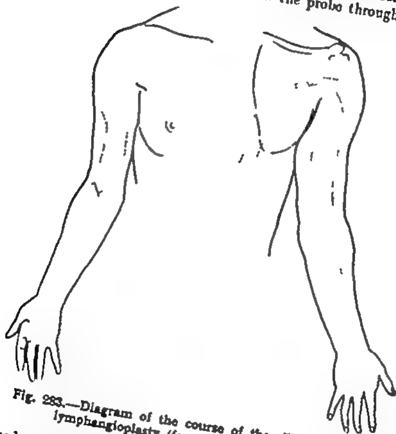


Fig. 283.—Diagram of the course of the silk threads in lymphangioplasty (front and back of arm).

last made and draw the silk after it as far as it will come. Introduce the probe through the incision from which it has just emerged, thrust it upwards again in the selected line, and repeat the foregoing steps until the point selected for the convergence of the threads is reached. Here an incision 1 in long is made, through which the probe with its two silk threads is drawn out. The other half of the silk loop is now led upwards in the selected line along the other border of the flexor surface. The limb is turned over and the extensor loop of silk is similarly introduced. When this has been done eight free ends of

silk are hanging out from the incision of convergence at the posterior border of the deltoid Two at a time, these are tucked away in various directions in the subcutaneous tissues of the back by the following manœuvre Grip a forceps on the selected pair of silk threads just where it emerges from the topmost incision. Take a long probe, cut off the ends of the two threads so that they are 4 in. shorter than the probe, and thread them into the eye. Thrust the probe downwards from the incision in the desired direction until the probe unthreads itself. Withdraw the probe carefully leaving the two silk *threads to occupy its track. Complete the operation by sewing up* the incisions with horsehair

The principal difficulties of the operation are connected with the maintenance of the silk in an aseptic condition. Owing to the large area dealt with, extending on to the back, the necessary changes in the posture of the arm, and the length of the silk threads, accidental contact may very easily occur between the silk and the surface of the skin the edges of the incisions, or surrounding objects. The silk ends not actually dealt with at the moment must be kept wrapped in sterile gauze which is also useful to protect them from the edges of the incisions as they are being drawn in after the probe. If necessary all the threads can be withdrawn by reopening the two incisions just above the wrist. I have never been obliged to do this. There is no need to fix the upper ends of the threads by knotting them together for the silk soon becomes adherent to the tissues along its whole length.

Lastly it is necessary to state that severe lymphatic œdema of the arm does not usually develop until within a few months of the patient's death from her disease. A long period of survival after the operation must not, as a rule, be expected. The aim of the operation is not the prolongation of that period, but its conversion from one of torture into one of comparative comfort.

Cases unsuitable for lymphangioplasty.—The operation of capillary drainage by silk threads is contra-indicated in cases where a general anæsthetic cannot be borne, and in cases where the threads would have to *pass through cancerous tissue. It is also inadvisable* to operate if there is growth present about the shoulder or if the pain is mainly axillary or is a lancinating pain shooting down the arm. In the presence of pleural effusion or secondary growths the operation is hardly worth doing, for its effects at best will be transient.

Amputation of the arm, or interscapulo-thoracic amputation, is the only resource in cases unsuitable for lymphangioplasty

Treatment of cancerous ulcers.—Ulceration of the growth is due primarily to necrosis of the central portions of the growth from nutritional failure. But, unless care be taken, the ulcer

becomes the seat of septic processes and the source of an offensive discharge These distressing evils can be prevented or mitigated by careful attention to the antiseptic dressing of the ulcer Strong antiseptics such as 10-volume hydrogen peroxide at full strength acetone, or zinc chloride 40 gr to the ounce may be applied once or oftener if the ulcer is foul. The separation of sloughs may be hastened by hot fomentations. Subsequently the ulcer is dressed daily with mild unirritating applications, such, for instance as boric lint boric ointment or lint wrung out of sanitas, or solution of cyllin 10–20 minims to the pint.

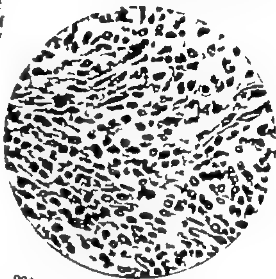


Fig. 284.—Spindle-celled sarcoma of the breast. × 230 Note the complete disappearance of the normal glandular elements of the breast. This is characteristic of sarcoma.

SARCOMA OF THE BREAST

Etiology—While it is perhaps rare for injury to play a definite part in the origin of carcinoma there can be little doubt that sarcoma of the breast is occasionally of traumatic origin (Coley) that is to say the sarcoma develops at the site of, and within a short interval after a single definite blow Bland-Sutton has drawn attention to the possible medico-legal importance of this fact

Fibro-adenoma and sarcoma.—A fibro-adenoma after persisting for years without marked change, may take on rapid growth, and may in a few months form a large tumour to which the name soft fibro-adenoma is applied. As a rule when the breast is removed the tumour is still found to be encapsuled and it does not recur In other cases a small tumour present for some time in the breast begins to grow rapidly and a large hemispherical mass is produced which soon fungates through the skin On removal an unencapsuled sarcoma is found to be infiltrating the breast If we remember in conjunction with these facts that the microscopic appearances of a soft fibro-adenoma resemble very closely those of a sarcoma, we may explain the statement made by various authorities that a fibro-

adenoma may become a malignant tumour of the sarcomatous type, and that the soft fibro-adenoma is either an intermediate form or an intermediate stage in the conversion These statements, though not generally accepted, are, in my opinion, correct [1]

The routine histological examination of tumours of the breast



Fig. 285.—Sarcoma of the breast.
(*Beatson, Edin. Med. Journ., Jan., 1909*)

has shown that sarcoma of the breast is much less frequent than it was formerly thought to be. Though some authors say that one malignant tumour of the breast in fifty is a true sarcoma this is probably an over-statement Many cases which present the clinical signs of sarcoma turn out to be soft carcinomas others to be cystic adenomas. Sarcoma of the male breast is excessively rare.

[1] But see Vol. I., p. 465.

Age-incidence.—Though it may occur at any age from childhood upwards, Rodman finds that sarcoma like carcinoma is a disease of middle life and that half the cases occur between the ages of 40 and 50

Clinical signs.—In an early stage the tumour is usually spheroidal in outline with a nodular or tuberose surface well circumscribed, and not adherent either to skin or fascia or to the surrounding



Fig. 236.—Fungating sarcoma of the breast.

breast substance. In this stage it resembles exactly an innocent fibro-adenoma or a mobile carcinoma and it is usually mistaken for one of these two conditions. The signs of contraction seen in a carcinoma are absent there is neither retraction of the nipple nor skin-adhesion In this condition it may remain, sometimes for years, as a slowly growing tumour of no great size—a peculiarity which seems to confirm the idea that sarcomas usually originate in an innocent encapsuled fibro-adenomatous tumour But at the time the surgeon sees the tumour it is usually growing with great rapidity and that fact, together with its comparative softness, gives the clue to the

diagnosis. At this stage the breast forms a large, prominent, hemispherical mass, lobulated in outline, with large veins coursing over its surface. Already if not earlier the tumour has infiltrated through its capsule, and signs of adhesion, though not of contraction, become manifest. The skin is now tacked down to the convexity of the tumour, and soon in this situation it becomes thinned and shiny then discoloured, until finally at the summit it gives way like an overstretched rubber sheet. Through the opening thus made a mass of sarcoma tissue fungates (Fig 286) rapidly increasing in size, and perhaps giving rise to serious hæmorrhages. The axillary glands are rarely enlarged, even in a late stage of the disease. Cystic degeneration of parts of the tumour is common, so that portions of the swelling may fluctuate. The tumour now becomes adherent to the subjacent muscles and the chest-wall. Life may be prolonged from one to several years and death occurs either from exhaustion and hæmorrhage or from dissemination in internal organs.

Chondro-Sarcoma of the Breast

In rare cases, sarcomas of the breast may contain areas of cartilage. Such chondro-sarcomas sometimes undergo calcification, or true bone with well marked Haversian systems may be formed in them. The patients are middle-aged or old the tumours are characterized by their stony hardness, but portions of them may be soft and fluctuating owing to the liquefaction of areas of cartilage. These tumours may quickly recur after operation and may become disseminated. Calcified cartilage has been detected in the secondary deposits (Bland Sutton).

In a case of chondro-sarcoma under my care a duct papilloma had been excised from the breast five years previously

Treatment.—Though in its early stage a sarcoma is easily enucleated without removal of the breast, such a method of treatment is almost certainly followed by recurrence of the disease in the scar The only satisfactory operation is one which includes removal of the breast and of the great pectoral muscles Clearing of the axilla is also advisable, though perhaps not always essential. All adherent skin must be ablated with a margin of at least an inch of healthy skin. The skin flaps should be reflected, as in the operation for carcinoma, and the deep fascia removed over a wide circular area. Skin-grafting is often necessary in large sarcomas, and should be done at the same time as the primary operation. In cases radically treated the prognosis as regards recurrence is much more favourable than in carcinoma.

Most of the photomicrographs illustrating this article were kindly taken by Mr. R. W Annison, M.R.C.S., from the writer's specimens.

SELECTED BIBLIOGRAPHY

Banks, Mitchell, "Removal of Axillary Glands in Breast Cancer" *Brit. Med Journ.*, 1882, ii. 1129.

Beatson, "Sarcoma of the Female Mamma," *Edin. Med. Journ.* Jan., 1909.

Benians, T. H. C., "The Use of Vaccines in Acute Mastitis," *Brit. Med. Journ.*, April 1., 1911

Bland-Sutton, "Secondary (Metastatic) Carcinoma of Ovaries," *Brit. Med. Journ.* May 26, 1906; *Arch. of Middx. Hosp.*, 1910, xix. 98.

Campiche and Lazarus-Barlow "Malignant Disease of Breast: a Statistical Study from Records of Middlesex Hospital," *Arch. of Middx. Hosp.*, 1905 vol. v

Cheatle, Lenthal, "A Clinical Lecture on Chronic Traumatic Mastitis," *Brit Med. Journ.*, March 4, 1911.

Coley W. B., "Injury as a Causative Factor in Cancer" *Ann. of Surg.*, May, 1911

Gould, Pearce, "Cases Illustrating Repair in Cancer of Breast," *Clin. Journ.*, May 9 1900.

Halsted, W. S., "Removal of Breast and Axillary Tissues in Breast Cancer" *Ann. of Surg.*, Nov., 1894.

Handley W. Sampson, "Centrifugal Spread of Mammary Carcinoma of Parietes, and its Bearing on Operative Treatment. *Arch. of Middx. Hosp.*, 1904 vol. iii. *Cancer of Breast and its Operative Treatment.* London 2nd Edit., 1922. "On Paget's Disease of the Nipple. *Brit. Journ. of Surg.*, Jan., 1919 No. 26, vii. 183.

Heidenhain, "Ueber die Ursachen der localen Krebsrecidive nach Amputatio Mammæ," *Arch. f. klin. Chir.*, 1889 B. 97

Leitch, Archibald, *Brit. Med. Journ.*, May 22, 1909. (A rapid staining method for use during operations.)

Lockwood, C. B., "An Address on Carcinoma of Breast," *Brit. Med. Journ.* Jan. 27 1906.

Moore, Charles, "Influence of Inadequate Operations on Theory of Cancer *Trans. Roy. Med.-Chir. Soc.*, 1867 l. 215.

Osler "Medical Aspects of Breast Cancer" *Brit. Med. Journ.*, Jan. 6, 1906.

Paget, James, "On Disease of Mammary Areola preceding Cancer of Mammary Gland," *St. Bart.'s Hosp. Repts.*, x. 87

Paget, Stephen, "Distribution of Secondary Growths in Cancer of Breast," *Lancet* March 23, 1889.

Piney A., "Carcinoma of the Bone-Marrow *Brit Journ. Surg.*, Oct., 1922.

Rodman W. L., *Diseases of the Breast.* 1908.

Sappey, *Vaisseaux Lymphatiques.*

Schmidt M. B., *Die Verbreitungswege der Karzinome.* Jena, 1903.

Shaw Ernest H., "Tumours of the Breast," *St. Bart.'s Hosp. Journ.*, May 1904; "The Immediate Microscopic Diagnosis of Tumours at the Time of Operation," *Lancet*, Sept. 24 1910.

Stiles, Harold, "On Dissemination of Cancer of Breast," *Brit. Med. Journ.*, 1880 i. 1452; "Contributions to Surgical Anatomy of Breast," *Edin. Med Journ.*, 1892; article in Burghard's *System of Operative Surgery*

Török and Wittelshöfer "Statistics bearing on Dissemination in Breast Cancer" *Arch. f. klin. Chir.*, 1881, xxv 873.

Velpeau, "Diseases of the Breast," *Sydenham Soc. Trans*

Williams, Roger *Diseases of the Breast.*

THE SPLEEN

By Sir CHARLES GORDON-WATSON K B E C.M G F R C S

Functions of the spleen.—Even at the present time our knowledge of the pathology of splenic disease is hampered by imperfect knowledge of the physiological function of the organ. The spleen is developed in the mesoblast of the mesogastrium and receives its blood and nerve-supply from the same source as the stomach, the liver and the pancreas. Though it possesses no duct leading into the alimentary tract, there are special features in regard to the blood it receives and distributes. The blood which enters the spleen comes into direct contact with the cells of endothelial type in the splenic pulp, and the blood which leaves the viscus enters the liver after mingling with the blood from the cardiac end of the stomach and the tail of the pancreas, then with the blood from the lower colon, and finally with the blood from the main portion of the digestive tract. Our knowledge of the action of the spleen on the blood thus diverted from the general to the portal circulation is imperfect, but there is much evidence to show that the splenic cells have phagocytic properties, that they develop hæmolytic ferments (probably intracellular) and act as mechanical strainers. In short, the spleen acts as a filter for and a digester of bacteria, parasites, toxins, and worn-out red blood-cells, and it deals with these in a special manner and forwards the products for further treatment to the liver The great vitality of many organisms held up in the splenic pulp accounts for the latency of many infections.

The spleen with its unstriped muscle-fibres is the sole remaining lymph heart in the mammalian body In embryonic life the spleen is a factory for the red cells and neutrophile leucocytes—a function which in postnatal life it hands over to the bone-marrow though it exercises, as recent experiments tend to show a controlling influence over the functions of the bone-marrow in the manufacture of both red and white cells. In some diseases we see a tendency for the spleen to resume this embryonic function in the production of large numbers of white cells.

The work of Sajous shows how important are the functions of the spleen in relation to digestion. We know that it enlarges during digestion and diminishes in the interval. Sajous describes a "spleno-pancreatic ferment" which, coming into action between the spleen and the liver detoxicates the blood which carries the food products. Chemical investigation has revealed that the spleen is closely concerned with purin, iron, and fat metabolism.

"Further experimental work," as Moynihan aptly says, "must consider the spleen not as an organ whose functions are confined to its own activities, but as a member of a group of organs each concerned with and influenced

by the activities of the others." The clinical problems of the diseased spleen must be studied in a similar manner. William Mayo, in an address to the Chicago Medical Society in 1910 on the spleen, says:—" It is a link in a chain of organs which, under conditions of disease produces changes in the blood that may eventually cause death. However the spleen constitutes only a single weak link in the chain, a link which may be removed. In many instances its removal breaks up a vicious circle and the patient is thus restored to health, even though the spleen itself may be only the agent of destruction rather than its cause. This conception of the function of the spleen brings into the foreground its relation to the pathology of the blood as a tissue—a tissue composed of leucocytes, erythrocytes and platelets, the plasma of the blood having the relation of connective tissues."

Effects of removal of the spleen.—The healthy spleen can be removed without causing any serious physiological disturbance.

A transitory diminution in the number of the red and a temporary increase in the number of the white blood-corpuscles follows removal. The deficiency is made up by an increased activity on the part of the bone-marrow and of the lymphatic glands. As accessory spleens are not uncommon hypertrophy of these may be expected to occur after removal of the main organ. The temporary anæmia which usually follows excision may in part be accounted for by the actual volume of blood removed with the spleen.

When the spleen is removed for splenomegaly with secondary anæmia the anæmia always improves, even though the disease is not cured.

In the initial leucocytosis an increase of the polymorphonuclears usually occurs. Later on and coincidently with the lymphatic enlargement, there is a definite lymphocytosis which has been known to continue in patients under observation for as long as three years after removal of the spleen. Eosinophilia may be observed either transitory or immediate and persisting for some years after operation. Warthin has shown by animal experiments that lymphatic enlargement occurs as a compensatory substitute for the spleen in the sheep and goat. It has been suggested that the pain which is often complained of along the bones of the limbs after splenectomy supports the view that the bone-marrow takes a part in compensation.

When the spleen has been removed, subsequent disease may produce the same changes in the blood as would occur if the spleen were present, and a case is recorded by Fuhs of a woman who suffered from both enteric fever and appendicitis after splenectomy for Banti's disease. During the enteric fever there was leucopenia, and during the appendicitis leucocytosis.

In some instances, after convalescence from splenectomy there has been a gradual onset of progressive emaciation with general weakness, headache thirst drowsiness, and irritability and some-

times with pyrexia rapid pulse and respiration. In two cases recorded by Ballance, in which this condition arose, ultimate complete recovery followed the administration of extract of sheep's spleen and bone-marrow and finally arsenic. This train of symptoms may depend on the loss of an internal secretion, or it may be that the bone-marrow and lymph-glands were unable at once to meet the demands made upon them so suddenly In other cases an element of sepsis may afford a reasonable explanation of such symptoms. The condition described is certainly not a common sequela of the operation.

Animal experiments, and notably those of Morris and Bulloch show that after recent splenectomy resistance to infection is greatly diminished. Observations to support this in man have yet to be made but the enlargement of the spleen in acute infections is suggestive that the spleen is concerned with immunity

SPLENECTOMY

Splenectomy should not be lightly undertaken. The mortality is high, though steadily improving with experience and more careful selection of cases. The chief dangers are shock and hæmorrhage. The size of the spleen and the presence of adhesions may present serious difficulties.

G B Johnston in 1908 collected 708 cases of splenectomy showing a mortality of 27·4 per cent. If the cases of removal for injuries are excluded (150 with 51 deaths) the mortality was 13·2 per cent. Thursfield and Gow in 1914 collected 74 cases with a mortality rate of 12·1 per cent. More recently in 1920, the records of the Mayo Clinic show 26 deaths in 245 cases of all types, a mortality of 10·6 per cent.

Although the spleen has been removed for a great variety of conditions, the cases in which splenectomy is either desirable or suitable are in the main limited to (1) injuries or ruptures which endanger life from hæmorrhage ; (2) strangulation of a normal or diseased spleen, due to torsion of the pedicle ; (3) hypertrophy combined with excessive mobility when causing troublesome symptoms (4) hydatid and other forms of cystic disease (5) primary malignant disease, if recognized early (6) malarial hypertrophy when the size of the spleen is a menace to the patient's life ; and (7) some cases of splenic anæmia, pernicious anæmia, and hæmolytic jaundice.

The operation.—The most convenient incision is a vertical one along the outer border of the left rectus. When the diagnosis is uncertain a median incision is usually employed and if necessary the left rectus is subsequently divided transversely In the case of very large tumours, and especially in women, in whom the subcostal arch is less divergent than in the male, the median incision is probably the most suitable, as it allows of a longer incision than can be secured

in the linea semilunaris. Some surgeons adopt an oblique incision parallel to the costal arch.

If adhesions exist they must be dealt with before any attempt is made to ligature the pedicle. If adhesions are extensive between the spleen and neighbouring viscera it will often be advisable to abandon the operation. Adhesions between the spleen and the parietal peritoneum are best dealt with by gentle pressure with swabs on holders. When the spleen has been separated from the parietes the splenic space should be well packed with gauze to check oozing. Omental adhesions must be carefully transfixed and ligatured. It is important to liberate the upper pole first, so as to get control of the pedicle.

Before the pedicle is ligatured the spleen should if possible be delivered outside the abdomen. The pedicle is most easily approached when the spleen is rotated so that the posterior surface looks forward. The vessels should be separately ligatured with stout catgut, and divided at some distance from the ligatures. The pedicle when released slips away out of sight and fatal results have followed the slipping of a single ligature round the entire pedicle. In longstanding cases of mobile spleen the vessels have often shown atheromatous changes. The greatest care must be taken to avoid undue tension of or torsion on the large splenic veins. Some surgeons have, by accident, or design to lend support and security to the vascular stump, included the tail of the pancreas in the ligatures. The possibility of a pancreatic fistula resulting must be borne in mind.

It must be remembered that the splenic artery breaks up into from five to seven branches when it reaches the spleen, and that the vasa brevia are branches of the splenic artery to the greater curvature of the stomach, running in the gastro-splenic omentum. These, together with the gastro-epiploica sinistra (the large vessel supplying the cardiac end of the greater curvature of the stomach) should be avoided if possible, when separating the spleen from the stomach by division of the gastro-splenic omentum. The splenic artery ends by crossing the upper end of the left kidney and its terminal branches pass through the lieno-renal ligament to reach the hilum, so that the close relationship of the spleen to the kidney must be remembered when the pedicle is dealt with.

In some instances dragging on the pedicle has produced alarming symptoms of collapse probably due to injury of the splenic nerve plexus, which arises from the solar plexus and runs with the splenic vessels.

The capsule of the spleen is normally very thin, and the splenic tissue very friable, so that rough handling of the viscus is to be avoided

i

When, owing to anatomical difficulties or constitutional disability excision of the spleen in such cases as splenic anæmia seems to offer too great a risk, ligature of the majority of the branches of the splenic artery as suggested by William Mayo, may be tried as a palliative measure, on the analogy of ligature of thyroid vessels in exophthalmic goitre.

Complications.—As stated above, shock in these cases is often severe. Hæmorrhage during operation should be negligible when the spleen is freely movable, but may be serious when adhesions are extensive. When the organ is very large, much blood may be removed in it, so that the artery should be tied before the vein. Thrombosis may occur in the splenic vein after splenectomy and cause serious gastric hæmorrhage and cases have been recorded of thrombosis spreading to the superior mesenteric vein, causing vomiting, collapse, gangrene of the gut, and death.

RUPTURE OF THE SPLEEN

In severe injuries to the abdomen (e.g when a cart wheel passes over the thorax or abdomen) the spleen may be torn, severely lacerated or even severed from its vascular pedicle. Such a case generally presents associated injuries to the liver or other viscera, with or without injuries to the bones of the thoracic wall, and only occasionally comes within the range of surgical interference. In other instances a crush or blow upon the abdomen may produce an injury to the spleen without damage to other viscera, and be followed by grave internal hæmorrhage which demands prompt operative treatment. In a few instances a similar result has followed a fall without any direct blow upon the abdomen.

When the spleen is enlarged, as in malaria, even slight injuries have been known to produce rupture of the capsule and severe internal hæmorrhage (p 121) and spontaneous rupture of the spleen sometimes occurs in enteric fever and in splenic infarction.

Diagnosis.—Traumatic splenic rupture can seldom be diagnosed with certainty but may be assumed when signs of internal hæmorrhage are associated with injury in the splenic region especially if at the same time the natural splenic dullness is increased. Deepening pallor restlessness, great thirst, acute abdominal pain, and faintness are combined with a pulse which diminishes in volume as it increases in rate until it becomes running and almost imperceptible. Abdominal rigidity is soon general, but is locally exaggerated and may be accompanied by tenderness in the left subcostal region. If the hæmorrhage is abundant, a shifting dullness in the flanks soon follows—a valuable sign when obtained. If, when the signs of fluid are increasing, the dullness in the right flank can be made to shift by a change of position,

while that in the left remains constant, an injury to the spleen is strongly suggested. In many cases of severe abdominal injury it is quite impossible at first to arrive at any certain diagnosis and it may be difficult at that stage to decide whether a patient is suffering only from severe shock, or from collapse due to a concealed hæmorrhage.

Treatment.—In all cases of suspected injury of the spleen, exploratory laparotomy is imperative if there are signs of internal hæmorrhage. The question whether laparotomy should be immediate or whether reaction from the shock and collapse incident to the injury should be awaited can only be decided by the circumstances of the individual case.

Speaking generally, *delay is dangerous*. Frequently, by slowing of the heart's action and temporary clotting, natural arrest of hæmorrhage occurs, and encourages the surgeon to hope that by masterly inactivity he may allow the arrest to become permanent without subjecting the patient to the additional danger of operation; too often, however, recovery from shock leads to a recurrent and not seldom fatal flood of hæmorrhage.

On the other hand, cases occur in which, after the initial hæmorrhage has ceased, recovery without recurrence follows.

There are two specimens in the Museum of St. Bartholomew's Hospital which demonstrate repair of the spleen after rupture from injury. One (Fig. 287) is the spleen of a woman aged 20, who, falling 30 ft. from a window fractured her femur and died ten days later, but without symptoms of abdominal injury. At the autopsy it was apparent that the spleen had been torn across, and a firm white scar had formed (½ in. thick), uniting the lacerated surfaces. There was also an encapsuled collection of blood (partly fluid) around the spleen, and the subperitoneal tissue in the neighbourhood was stained with blood pigment.

The other specimen (2308a) was removed post mortem from a woman aged 39 who was run over by an omnibus, and died sixty hours later. The spleen had been torn on the outer surface near the upper extremity, and the rent was closed by a firm clot.

Doubtless similar specimens are to be met with elsewhere.

Each case must be judged on its merits. Some cases are hopeless from the first, but in most the collapse resulting from the loss of blood opens a loophole for recovery, although, as already stated, a recurrence of hæmorrhage usually follows. Occasionally the spleen may be injured and yet no symptoms of hæmorrhage occur for many hours or even days after the accident. Possibly in some of these cases the bleeding first occurs beneath the capsule and intraperitoneal hæmorrhage only follows a subsequent rupture from the tension of the blood effused beneath the capsule; in others a temporary clot may occur and yield subsequently to a recurrent or secondary hæmorrhage. If

the patient survive the hæmorrhage and no operation be performed he may yet succumb to peritonitis, which sometimes follows large effusions of blood into the peritoneal cavity

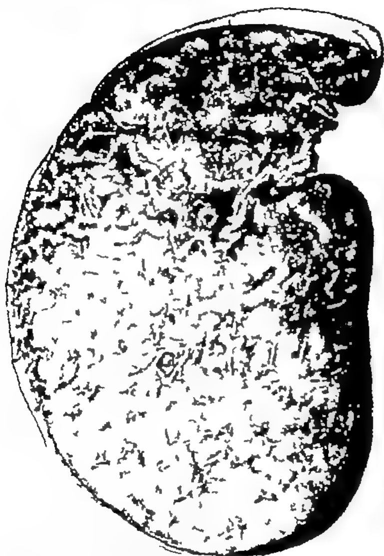


Fig. 287.—Rupture of the spleen: spontaneous cure. The site of the injury is occupied by a firm white scar measuring $\frac{1}{2}$ in. across.

(Specimen 2988a, St. Bartholomew's Hospital Museum.)

In hospital practice and in private practice when surgical aid is obtainable, preparation for an operation should be made as soon as a diagnosis is established. Meantime, absolute rest and freedom from any disturbance must be enforced. The foot of the bed should

be raised and the extremities firmly bandaged If operation decided on, continuous subcutaneous saline infusion should be commenced as soon as the abdomen has been opened. For this purpose the rubber bags designed by Arbuthnot Lane are very efficient. As some uncertainty as to the nature and extent of the injuries in these cases must always exist it is advisable to open the abdomen freely in the middle line above the umbilicus so that the liver and kidneys as well as the spleen can be examined. If it is found that the spleen only is ruptured, further procedure will depend on the extent of the injury and it may then be necessary to divide the left rectus transversely

In most cases splenectomy (p 112) is advisable In cases of minor injury packing with gauze may suffice to arrest bleeding, but this method is not free from risk of subsequent hæmorrhage, and may be followed by infection, suppuration, and a septic sinus. In extreme cases however when the collapse is so great that excision seems out of the question, it may be employed.[1]

Attempts to suture tears in the spleen have usually failed, and time devoted to this procedure will be more profitably spent in ligaturing the splenic vessels and excising the damaged viscus. If suture be employed, the linked mattress-suture should be used as less liable to "cut out" than other forms of suture

Immediately the splenic origin of the hæmorrhage is ascertained an assistant should secure and digitally compress the splenic vessels until the surgeon is prepared to ligature these and remove the organ. Owing to the special risk of infection, the ligature material should be stout but absorbable catgut, rather than non-absorbable silk. At the conclusion of the operation all blood-clot should be removed from the abdomen, and the peritoneal cavity flushed out with hot saline solution (115–120 Fahr.) As a rule, drainage is unnecessary As much saline solution as possible should be left in the peritoneal cavity Rectal or subcutaneous infusion should be continued after the operation, and regulated by the condition of the pulse.

Complications.—Sepsis is the complication most to be feared. More than one case has been recorded in which, subsequent to the operation, inflammatory symptoms have resulted in the ligature of the stump being coughed up Pneumonia and empyema frequently follow operation, and may be explained, in some cases at any rate, by associated injuries to the lung and thoracic wall. In other cases subphrenic abscess, fæcal fistula, and secondary hæmorrhage have

[1] D'Arcy Power successfully plugged the splenic area in the case of a boy who was kicked by a horse and who developed symptoms of severe hæmorrhage two days after the injury Encouraged by this success, he employed the same method on the next occasion that he operated for ruptured spleen, but unfortunately the hæmorrhage recurred and death resulted.

occurred. All these complications may follow injury to the spleen without operation

Other possible complications which require brief reference are—(1) recurrent hæmorrhage, which may either result from the slipping of a ligature or arise from points of adhesion as the blood-pressure increases after recovery from collapse (2) secondary hæmorrhage from sepsis (3) the obscure train of symptoms (emaciation, etc.) mentioned (p. 110) (4) thrombosis of the splenic vein, which may extend to the mesenteric veins and so give rise to grave abdominal symptoms suggestive of intestinal obstruction, or apart from this, may be responsible for severe hæmatemesis

PROLAPSE OF THE SPLEEN

(Movable Wandering Ectopic Spleen)

This condition is rare in men, and more frequent in women who have borne children. Although abnormal mobility of an otherwise natural spleen may occur particularly in cases of general enteroptosis, prolapse is usually associated with hypertrophy When the phrenico-colic ligament, which normally suspends the spleen beneath the diaphragm, is stretched or torn the spleen readily prolapses, and is then very imperfectly supported by the splenic vessels, the gastro-splenic omentum, and the lieno-renal ligament.

A movable spleen if not greatly enlarged, may give rise to no symptoms at all Great mobility especially if combined with considerable hypertrophy induces severe spasms of pain closely simulating those of movable kidney [1] Owing to the close connexion between the spleen and the stomach through the gastro-splenic omentum, gastric disturbances are not uncommon

In extreme cases the spleen may be found to occupy the left iliac fossa, or to have crossed to the right of the middle line and it has been found impacted in the pelvis.

The loss of the normal splenic dullness, the absence of colon resonance in front of the wandering viscus, its superficial position, and its notched border should serve in most cases to distinguish it from a movable kidney but mistakes in diagnosis are frequent.

Treatment.—A well-fitting abdominal belt may in some instances prevent the pain and discomfort which sometimes result from a prolapsed spleen. In severe cases, especially in malarial hypertrophy excision (p 112) may be justifiable if the patient is so inconvenienced as to be unable to follow his employment or to enjoy active exercise. In a few cases the operation of **splenopexy** has been performed An incision is made through the parietal peri-

[1] L. Macdonald and W A. Mackay record an operation in a case of movable and twisted spleen which was mistaken for movable kidney

toneum under the left cupola of the diaphragm and the peritoneum freed from the parietes until the spleen can be passed through the parietal peritoneum and couched in such a way as to lie in contact with the diaphragm over the area from which the peritoneum has been stripped and to which it should become adherent It should be kept in position by suturing the stripped peritoneum together round the pedicle of the spleen. If firm adhesions quickly form, and the spleen is not greatly enlarged, this operation may be successful but if not the weight of the spleen the stretched pedicle and the constant movement of the diaphragm are factors which militate against fixation. Absolute rest on the back should be enforced for at least a month after the operation.

TORSION OF THE SPLEEN

The movable or wandering spleen especially if enlarged is very liable to become twisted on its vascular pedicle and to undergo strangulation through obstruction to the blood supply and ultimately gangrene with thrombosis of the splenic vessels. The condition is analogous to the twisting of the pedicle of an ovarian cyst or a retained testis, and the symptoms are very similar—acute abdominal pain and vomiting, and, if unrelieved, general peritonitis.

The strangulation may come on gradually or quite suddenly and if a movable spleen has not been previously recognized may so closely resemble acute perforation of a viscus or intestinal obstruction as to escape diagnosis before laparotomy

Treatment.—The only satisfactory method of treatment is that of splenectomy (p. 112) Splenopexy or simple relief of the strangulation, is liable to be followed by recurrence. It will be remembered that normally the spleen is slung beneath the arch of the diaphragm by the phrenico-colic ligament, and closely connected to the greater curvature of the stomach by the gastro-splenic omentum, and to the left kidney by the lieno-renal ligament. The tail of the pancreas lies in contact with the hilum of the spleen just below the point of entry of the large vessels. All these points should be borne in mind in dealing with torsion of a prolapsed spleen.

GUNSHOT WOUNDS OF THE SPLEEN

In the Great War wounds of the spleen were noted in about 5 per cent. of the abdominal operations. Associated injuries to other viscera were the rule rather than the exception—a fact which militates against success when splenectomy is performed. The other viscera were most frequently the left kidney and the splenic flexure, and after these the diaphragm and lower pleura It was a matter of general comment that associated wounds of stomach and spleen were rare

and certainly less common than wounds of the small intestine and the spleen. Penetrating bullet wounds may produce every variety of wound, from avulsion (complete or partial) total disruption of explosive type, to clean perforation. Not infrequently rupture occurs from non-penetrating wounds which cause fracture of the lower ribs.

The special symptoms of splenic hæmorrhage are usually masked by the general symptoms of abdominal wounds. The local, non-shifting accumulation of blood often noted in civil injuries of the spleen has not been observed as a special feature of gunshot injuries.

Treatment.—Gunshot injuries of the spleen are usually discovered during laparotomy and after hæmorrhage has ceased. In the absence of active hæmorrhage, the spleen should not be removed unless the main vessels are injured or the spleen is severely damaged, though danger of a fatal recurrent hæmorrhage must not be lost sight of. Each case must be judged on its merits. It is often necessary to remove the kidney at the same time. In multiple wounds, suture of the diaphragm and intestinal suture may add to the difficulty and risks. Recoveries occurred in the war under all such conditions. Even a small hole in the left cupola of the diaphragm should be sutured. Many large diaphragmatic hernias involving the entire stomach and perhaps other viscera have followed perforated bullet wounds, and there is no doubt that with the piston-like suction of the diaphragm these holes rapidly enlarge. Apart from the risk of hernia, these holes require suture because of the respiratory distress which they produce. This distress occurs independently of hæmothorax and pneumothorax and is, in the writer's experience, promptly removed by suture. Wounds of the diaphragm in association with splenic injury may easily be missed if not looked for When the chest wall or pleural cavity requires surgical treatment, wounds of the diaphragm can be best dealt with from above

SPLENOMEGALY

In recent years much valuable work has been done in the differentiation of the various types of splenomegaly and a wider field has been found for the relief which the surgeon can give by splenectomy Thursfield and Gow have classified splenomegaly as follows —

1. *Due to mechanical obstruction.*—Hepatic portal cirrhosis. Thrombosis of the splenic vein. Enlargement in decompensated cardiac disease.
2. *Due to acute general infections.*—Typhoid fever Infective endocarditis. Pyogenetic septicæmia.
3. *Due to chronic infective processes*—Tuberculosis. Syphilis. Lymphadenoma.

4 *Due to protozoal infections*.—Malaria Kala-azar ? Egyptian splenomegaly ? Ponos.

5 *Due to new formations*.—Cysts, parasitic and non-parasitic. Malignant growths. Endothelioma (Gaucher's type of splenic anæmia) Amyloid degeneration.

6. *Associated with disorders of the blood*.—Idiopathic pernicious anæmia Leukæmia. Von Jaksch's pseudoleukæmic anæmia. Acholuric jaundice, congenital and acquired. Vacquez's disease

7 *Primary*.—Splenic anæmia Splenic anæmia with hepatic cirrhosis (Banti's disease) Splenomegalic cirrhosis.

Many of these conditions do not, as yet, call for surgical interference by splenectomy The following may be regarded as the most important of the splenomegalies for surgical consideration viz. (1) Malaria, (2) splenic anæmia (3) acholuric jaundice, (4) myelogenous leukæmia.

(1) Malaria

Chronic splenic enlargement without obvious cause is not common in this country but White Hopkinson states that in Southern China and the Malay States it occurs in about 90 per cent. of the population. Some cases may be explained by past acute infective disease or by latent malarial infection. Others are probably due to unrecognized syphilis. Such an enlarged spleen is liable to prolapse and therefore to cause not only inconvenience but danger from torsion of the pedicle, intestinal obstruction, or pressure on other organs.

Chronic malaria is by far the commonest cause of splenic enlargement in tropical countries. A malarial spleen (ague-cake) may attain an enormous size and become a veritable burden to the owner The soft and moderately enlarged spleen of acute malaria usually yields to medical treatment. The hypertrophied spleen of chronic malaria may exist for many years without giving rise to symptoms. Excessive hypertrophy combined with abnormal mobility leads to considerable risk of rupture following on slight injury

Death has been known to ensue in a few minutes after turning in bed, a "flick with a cane a dig in the ribs" (Battle) The late Surg.-Gen. Coull Mackenzie states that 68·9 per cent. of cases of rupture of malarial spleen ended fatally within half an hour A not uncommon method of assassination in Southern China is by a blow in the abdomen with a cruciform iron instrument known as a "larang," in order to rupture the spleen (Crawford) Rupture of a malarial spleen may be compared to that of an aneurysm rupture of a normal spleen to that of a large artery (Battle)

Splenic abscess sometimes occurs in patients suffering from

malarial cachexia. It may be suspected if pain and tenderness with a rise of temperature and leucocytosis are noted after the disappearance of the parasite from the peripheral blood.

Treatment.—The large spleen of chronic malaria is often accompanied by extreme anæmia, and for this reason, as also for extreme mobility and torsion, or to avoid the risk of torsion or rupture, it has been frequently removed. According to Jonnesco to remove the spleen is to remove the breeding place.

Statistics show that the mortality of the operation is high for malarial hypertrophy but Johnston's table indicates that the mortality is much lower when the hypertrophy is accompanied by increased mobility This fact is probably accounted for by the comparative ease with which a movable spleen, even though of considerable size, can be delivered outside the abdomen. The rate of mortality for simple malarial enlargement (in the absence of ectopia or torsion) is not encouraging to the surgeon.

Vanverts states that of 39 splenectomies for malarial hypertrophy with adhesions 28 died whereas out of 35 for hypertrophy without adhesions only 2 succumbed.

Operation is only indicated when the condition is complicated by excessive mobility and when by reason of the patient's occupation there is danger of rupture or torsion.

(2) Splenic Anæmia (Banti's Disease)

This is a chronic disease of young adult life, of unknown origin, but considered to be primary in the spleen.

Some confusion exists as to the precise relationship of Banti's disease to splenic anæmia. Banti describes three stages of the disease which goes by his name—(1) splenomegaly with a greater or less degree of anæmia, (2) changes in the urine with presence of urobilin, (3) ascites and cirrhosis of the liver without fever

The early stages are undistinguishable from splenic anæmia. It is still a matter of dispute whether these are distinct diseases, or whether splenic anæmia progresses to a fatal termination in some cases *without* cirrhosis and in others *with* cirrhosis. Most authorities lean to the latter view

Signs and diagnosis.—Briefly the spleen enlarges *pari passu* with progressive anæmia, diarrhœa, vomiting, gastric and intestinal hæmorrhage. No enlargement of the lymphatic glands occurs, and death usually results often as long as twelve or more years after the onset, from exhaustion or hæmorrhage. The first change in the blood is a diminution of hæmoglobin and, to a lesser degree, of red corpuscles. Later, the diminution of red corpuscles and of hæmoglobin becomes extreme. The coagulability of the blood is also diminished.

The white corpuscles are both actually and relatively reduced. The differential count should show no marked changes, and myelocytes are absent. The fragility of the red cells is diminished or normal and this test serves to differentiate splenic anæmia from *acholuric jaundice* a disease which is associated with increased fragility. The spleen is always enlarged, often to five or ten times its usual size, and there is much proliferation of the endothelial lining of the blood sinuses. Atrophy and sclerosis of the Malpighian bodies occurs—a point of differentiation from *leukæmia*—and there is a general fibrosis of the capsule and reticulum. It is important not to mistake the enlarged spleen which may accompany *portal hepatic cirrhosis* for splenic anæmia, though in recent years splenectomy has been advocated, and in some instances successfully carried out, for portal cirrhosis.

Differential diagnosis.—*Egyptian splenomegaly* while closely resembling splenic anæmia in its blood changes, presents distinct clinical features—attacks of fever onset in the hot season, and early hepatic cirrhosis. Richards and Day have excised the spleen 22 times, with 4 deaths, for this disease. *Gaucher's type of splenomegaly* may be distinguished from splenic anæmia by brown pigmentation of the skin, wedge-shaped thickening of conjunctiva, and the great numbers of large mononuclear cells in the spleen, glands, and bone-marrow. *Lymphadenoma* may be differentiated by the glandular enlargement, absence of anæmia in the early stages, and leucocytosis rather than leucopenia. *Splenomegalic cirrhosis*, recognized as a disease distinct from splenic anæmia or Banti's disease is characterized by an acute course in contradistinction to the chronicity of Banti's disease, and by a moderate leucocytosis instead of leucopenia.

Moynihan has drawn up an admirable table showing the differential diagnosis of the various splenic enlargements, to which the reader is referred (see Bibliography p 134)

Treatment.—Without doubt many cases are completely cured by splenectomy if carried out early and before the onset of ascites. Medical treatment in the past has been unsuccessful in checking the progress of the disease, though relief can be given when the size of the spleen is excessive by the use of radium and X rays. Operation should not be undertaken soon after a serious hæmorrhage, or when the spleen is very large, before an attempt has been made to reduce it by radium.

Early surgical interference offers a good chance of recovery and quick convalescence the risks of the operation increase as the disease progresses, and in the later stages the mortality is very high. Adhesions to the diaphragm increase with the advance of the disease and are often responsible for serious hæmorrhage.

Of 61 cases collected by Johnston in 1908, 49 recovered. Thursfield

and Gow in 1914 collected 34 cases, with 6 deaths. The records of the Mayo Clinic up to September 1920, show 71 operations with 9 deaths, a mortality of 12·6 per cent.

(3) Acholuric Jaundice (Hæmolytic Jaundice)

Splenomegaly commencing in early infancy with jaundice and an absence of bile in the urine (except during exacerbations) is now recognized as a disease distinct from splenic anæmia. Though not invariably it is usually congenital and often familial. The disease runs a chronic course with occasional exacerbations. Many patients have lived to a ripe old age and are "more jaundiced than ill" (Chauffard) The distinctive differential features of this disease are increased fragility of the red corpuscles in saline solutions and an absence of itching of the skin or marked wasting Exacerbations of jaundice with fever and epigastric tenderness occur and may unless the differential diagnosis is carefully considered suggest obstruction by a calculus. Cholelithiasis is a frequent complication in the later stages.

There is an acquired type of acholuric jaundice which may run a more rapid course, and which, apart from surgical treatment, is invariably fatal. Gibson believes in an infective origin and in one case has isolated a streptothrix of the actinomyces type.

Treatment.—In slight cases no treatment may be necessary except during the crises if they occur When symptoms are troublesome, especially in the acquired form, splenectomy is indicated, though improvement may follow treatment by radium or X rays. Splenectomy has secured brilliant results. Thursfield and Gow collected 10 congenital cases with 1 death, and 6 of the acquired variety with no death. The record of the Mayo Clinic of splenectomy for hæmolytic jaundice up to 1920 is 32 cases with 1 death. The fatal case was operated on during a crisis in a few hours delirium occurred, followed by coma and death in forty-eight hours. A complete cure may be expected to follow recovery from splenectomy

(4) Pernicious Anæmia

Pernicious anæmia is the title given to profound anæmia arising from an increased destruction of red corpuscles due to a hæmolytic poison. How far the spleen is responsible for this disease is uncertain but it has been said that if the spleen is the mother of pernicious anæmia there must be many fathers. Death occurs in pernicious anæmia because of the persistence of the increased destruction of red cells at a time when the efforts of the medulla to form blood break down under the ceaseless, heavy strain imposed upon it" (Moynihan)

Recent work by N M Percy and others, quoted by Moynihan shows that frequently the disease is associated with if not caused by infections of the gastro-intestinal tract. In 20 out of 24 cases Percy records chronic cholecystitis, with or without gall-stones in 17 of these there was evidence of old disease of the appendix in 6 there were infective foci in the teeth, and in 1 in the tonsil In diagnosis Percy lays stress on the presence of achlorhydria glossy tongue, pigmentation, chronic nephritis, intermittent diarrhoea and vomiting, and nerve symptoms such as tingling in the extremities.

Treatment by splenectomy—During the past ten years splenectomy has been advocated and occasionally practised, chiefly on the evidence of diminished hæmolysis following splenectomy for other diseases. Splenectomy alone has not resulted in permanent benefit. The aim of the surgeon in these cases should be, according to Percy (1) to improve the anæmia by stimulating the production of new blood by graduated blood transfusions at ten days interval—"step-ladder transfusion (Moynihan) (2) to remove all infective foci in the mouth accessory sinuses, etc. (3) to protect the newly formed red cells by splenectomy if marked improvement has followed (1) and (2) Treatment on these lines is not yet established as orthodox. At the Johns Hopkins Hospital, splenectomy for pernicious anæmia has now been given up. Moynihan summarizes the position as regards splenectomy as follows —"In the first place, it cannot be claimed and is not claimed that any patient has been cured of this disease The risks run in undergoing the operation are small, but not so insignificant that they can be ignored. A few lives are sacrificed. All the patients who survive are not benefited but in the majority a degree of improvement results and a prolongation of life, in greater comfort and with increased zest, can be recorded. The truth is approximately this that as a result of repeated transfusions of blood, removal of the spleen, and eradication of all foci of infection one-quarter of the patients are greatly improved, living happier and more useful lives, prolonged beyond the expectation by a period of two or three years one-half the patients are improved in some degree ; the remaining quarter do not receive any help greater than that which could be derived from careful medical treatment, which may include the step-ladder transfusions and the treatment of such septic foci of infection as can be found in the mouth, nose, or accessory sinuses.

Giffen and Szlapka have reviewed the results of splenectomy in 50 cases of pernicious anæmia, all of the patients being operated on more than three years ago 3 died of the operation 10 survived over three years, 5 had survived four and a quarter years and were still living

(5) Myelogenous Leukæmia

The characteristic changes in the blood in leukæmia of the myelogenous type are a great increase in the total number of white corpuscles and the presence of myelocytes.

The distinction between splenic leukæmia and splenic anæmia and allied conditions can be made by a differential blood-examination. In the former we find great over production of white cells, and in the latter excessive destruction of red cells. W J Mayo draws an analogy between this disease and carcinoma in the former the blood forming organs are concerned with the over production of white cells—a reversion to the embryonic type of blood in the latter an unlimited production of embryonic epithelial cells occurs. If the blood can be regarded as a tissue, leukæmia may well be regarded as carcinoma of the white blood tissue.

Treatment.—Until quite recently a very high mortality has followed from attempts to cure this condition by splenectomy In Johnston s table, only 6 out of 49 patients survived operation, but the Mayo Clinic figures up to September 1920 show only 1 death in 26 cases, with 7 patients still surviving (5 in good and 2 in fair condition) three to four years later These improved results as regards operation have followed preliminary treatment by radium.

Radium applied over the spleen produces rapid diminution in size and a rapid fall in the white cells, and a general improvement in the patient s condition but the improvement is only temporary It seems that during the stage of improvement splenectomy can be carried out with less risk.

There is no evidence at present that the disease can be cured by splenectomy and the most that can be said is that the disease is kept in abeyance for a time and that life thus prolonged is rendered more endurable by relief from the weight of the spleen.

SPLENIC ABSCESS

In general blood infections the spleen is frequently the seat of acute congestion The circulation in the large capillaries and veins is slow and the walls of the vessels are very pervious so that micro-organisms are readily deposited from the blood-current Abscess of the spleen may occur in the course of acute infective disease—e.g. enteric fever—or in any general pyæmia. It not uncommonly results from the breaking down of a septic infarct—e.g in infective endocarditis—and sometimes follows on injuries, the abscess probably resulting from the breaking down of a hæmatoma.

The pneumococcus has been found in some cases of acute splenic abscess (Fig. 288) and J P Maxwell has recorded 2 cases of

splenic abscess in South China in which he found the amœba of dysentery

Acute hæmorrhagic necrosis has been noted in rare instances in



Fig 288.—Single abscess of the spleen. The specimen was removed from a man æt. 49, who died with pneumonia. It weighed 50 oz. unopened, was adherent to the diaphragm, and contained a reddish brown turbid fluid. The right lung was consolidated, and contained an abscess with similar contents.

(Specimen [illegible] St Bartholomew's Hospital Museum.)

association with acute hæmorrhagic pancreatitis. Spontaneous rupture has occurred in this condition.

Chronic suppuration may be due to tuberculosis, actinomycosis or hydatid disease or result from the breaking down of a gumma or a septic infarct.

A splenic abscess may rupture and invade the general peritoneal cavity the subphrenic space the stomach, or the colon, or may burst through the diaphragm and cause an empyema.

Perisplenitis and adhesions readily form. The area of splenic dullness increases, and, when adhesions form with the abdominal wall localized swelling and œdema may occur.

Diagnosis.—The diagnosis of splenic abscess is based on the general signs and symptoms of suppuration—a septic temperature, leucocytosis, etc —and the local signs of pain, tenderness, and swelling in the situation of the spleen. The condition may generally be distinguished from renal suppuration by the absence of colon resonance between the tumour and the anterior abdominal wall.

Treatment.—The treatment follows general surgical principles. In several cases the spleen has been excised, but in the majority of cases the operation would be not only difficult, but dangerous owing to the adhesions and the risk of rupture of the abscess and infection of the peritoneal cavity Splenotomy with free drainage, if possible by an incision below the costal arch, or after resection of a portion of a rib or ribs, below the level of the base of the lung, should be adopted in most cases. If no adhesions exist between the spleen and the anterior abdominal wall, the greatest care must be taken to avoid infection of the general peritoneal cavity Before the abscess is opened the surrounding area must be carefully packed with gauze and when the pus has been evacuated the abscess wall should be sutured to the parietes. Or the operation may if the case is not urgent, be performed in two stages after the spleen has been exposed and the abscess localized, the wound is packed until the spleen becomes adherent and the abscess is not opened till about two days later

INFARCTS

Infarction of the spleen consequent on infective endocarditis or some other general infection does not come within the scope of surgery

Occasionally infarction may follow thrombosis of the splenic or portal vein, and under such conditions the infarct may rupture and give rise to hæmorrhage or general peritonitis (Collins Warren).

In the Museum of St. Bartholomew s Hospital there is a specimen (1914c) illustrating a chronic gastric ulcer in the cardiac region, with thrombosis of the splenic vein and an infarct of the spleen The patient succumbed after severe hæmatemesis. In this case the thrombosis and infarction undoubtedly followed the ulceration, spreading from one of the gastric vessels which join the splenic vein. Throm

bosis of the splenic vein is not uncommonly met with in infarction of the spleen and also in cases of torsion of the spleen and may lead to severe hæmatemesis. This is illustrated by a specimen (St Bartholomew's Hospital Museum 2271B) of a large pancreatic cyst which produced fatal hæmatemesis owing to pressure on and subsequent thrombosis of the splenic vein.

An infarcted spleen may rupture spontaneously or from slight violence. A case is recorded by Collins Warren of rupture of an infarcted spleen simulating an acute perforation by a gastric ulcer for which laparotomy was performed. A quantity of blood was found in the peritoneal cavity and a large rent in the spleen. The spleen was removed, but the patient succumbed. At the autopsy the portal and splenic veins were found thrombosed. Warren, in his account (see Bibliography p. 134) says "It would seem highly probable that distension of the capsule nearly to the bursting point by the cutting off of the egress of the blood by thrombosis of the splenic vein had prepared the way for rupture of the capsule by slight violence."



Fig 280 —Actinomycosis of the spleen. From a woman æt. 35, who also had extensive actinomycosis of the liver The upper pole of the spleen is seen to be adherent to the diaphragm and liver

(Specimen 2960c, St. Bartholomew Hospital Museum)

Should an infarct of the spleen break down and result in an abscess it may require to be dealt with on the lines already laid down (p 128)

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THE SPLEEN IN TUBERCULOSIS

In generalized tuberculosis the spleen is very commonly affected Occasionally primary caseous tubercle develops in the spleen and may require to be treated surgically either by excision when extensively involved, or by splenotomy scraping, and drainage if adhesions are extensive or if the deposit of tubercle is limited to a single focus and the spleen not greatly implicated.

THE SPLEEN IN ACTINOMYCOSIS

Actinomycosis is sometimes met with in the spleen (Fig 289) though far less frequently than in the liver Should the condition be recognized before adhesions have formed, and before suppuration has spread to the abdominal wall, excision of the spleen is indicated. Usually it will only be possible to deal with the case on lines appropriate to chronic suppuration. Surgical treatment should be supplemented by large doses of iodide of potassium, increased up to 200 gr per diem, and a vaccine treatment may be tried.

SPLENIC SYPHILIS

Large gummata are sometimes met with in the spleen (Fig 290), and are not easily diagnosed without an exploratory operation. The spleen has been excised on several occasions for this condition when the gumma has failed to respond to antisyphilitic remedies.

Syphilitic splenomegaly is usually associated with some anæmia which rapidly disappears after splenectomy Associated gummata in the liver are not uncommon, but, unless extensive, should not of themselves be an objection to splenectomy Cases with gummata in both organs have been recorded which failed to respond to syphilitic remedies but improved rapidly after splenectomy and were finally cured by subsequent antisyphilitic treatment. The Wassermann reaction in these cases is often negative.

Some cases of chronic hypertrophy of the spleen are regarded as syphilitic, and it is advisable to administer iodide of potassium in all cases of hypertrophy of uncertain origin.

Difficulties in diagnosis may occur Osler has reported a case of syphilis of the liver with the picture of Banti's disease. At the age of 7 the patient had arthritis and nodes, large spleen and normal blood, but a negative Wassermann. At the age of 11 three months before death, the blood showed reds 5 770 000 (hgb 65 per cent.) whites 4 640 He died with hæmatemesis and ascites, the reds falling below 2,000,000 At autopsy the liver was studded with gummata. Thursfield and Gow regard the high red count (before the hæmorrhage) as extremely uncommon in any stage of splenic anæmia and common in syphilitic splenomegaly



Large hydatid cyst of the spleen. From a woman aged 54 who died of acute bronchitis in an asylum. There were no symptoms to draw attention to the spleen. No other hydatid cysts were found post mortem.

(*Sp. m. 3601 St Bartholomew Hospital Museum.*)

PLATE 85.

Fluctuation or hydatid thrill may sometimes be obtained.

Multiple cysts are also met with.

Bland-Sutton states that the six hooked embryo prefers loose subserous tissue, and that in the case of the spleen the parasites first occupy the meshes of the gastro-hepatic omentum and then gradually invade the splenic pulp from the hilum. A diagnosis may sometimes be established by the complement fixation test.

Treatment.—Exploratory puncture should never be employed. *If the cyst is of moderate size and adhesions are limited,* splenectomy is advisable but considerable caution is necessary to avoid rupture in dealing with adhesions

If adhesions are extensive it is safer to fix the cyst wall to the parietes and to incise and drain.

Single *blood cysts* (often of large size) *serous cysts, lymph cysts* and a few rare instances of *dermoid cysts* have been met with in the spleen

CAVERNOUS ANGIOMA OF SPLEEN

A few cases of this rare disease for which the spleen has been successfully removed, have been recorded (Hoge)

The spleen to the naked eye is dark, soft, and highly vascular. Microscopically the capillary system is lost and the blood collects in a number of freely intercommunicating spaces closely resembling in structure the corpus cavernosum of the penis. The walls of these spaces consist of thin connective tissue with an epithelial lining

SARCOMA OF SPLEEN

The spleen, though sometimes attacked by secondary deposits both of carcinoma and of sarcoma is very seldom the seat of primary sarcoma (Fig 291)

A sarcoma arising in the spleen will grow rapidly and give rise to a hard irregular tumour Metastasis will occur early and wasting and cachexia may be the only symptoms to attract attention. Pain *is not likely to occur in the early stages unless the tumour is on the* surface and the peritoneum is involved. In some cases a leucocytosis together with eosinophilia has been noted

The **diagnosis** of sarcoma will usually be made by a process of exclusion, but a hard and irregular nodular tumour should **always** suggest malignancy Splenic anæmia, leukæmia, and malarial enlargement, etc. can be excluded by the absence of the characteristic changes in the blood or by the history of the case

Prognosis and treatment.—If the disease is recognized early and if splenectomy is performed before metastases have formed the prognosis may be not unfavourable. Johnston has collected 12



Fig. 291 —Primary round-celled sarcoma of spleen. Removed from a woman æt. 49, who had suffered for a week with pain eight months prior to operation, and since then had been much subject to vomiting. She made a good recovery from the operation, but death occurred six months later

(*Specimen 3590 S. Bartholomew's Hospital Museum*)

cases of splenectomy for sarcoma, with 9 recoveries from the operation. Councill in 1912 collected 16 cases of splenectomy for sarcoma 7 of the patients were reported in good health at varying periods, the longest periods being six and a half six, and four years. If the after histories of these cases were traced it would probably be found that in the large majority death from recurrence had ultimately resulted, as in the case to which Fig 291 relates.

ENDOTHELIOMA OF SPLEEN

Cases of splenomegaly occur in which there is great proliferation of the endothelium of the blood sinuses. Weichselbaum regards this condition as endothelioma. Others regard it as hyperplastic (Gaucher's splenomegaly) rather than neoplastic.

SELECTED BIBLIOGRAPHY

Ballance, *Lancet*, 1890, i. 484.
Battle, Annual Oration, Med. Soc. of London, 1910.
Bessel-Hagen, *Arch. f Klin. Chir.*, 1900, vol. lxii.
Councill, *Ann. of Surg.*, 1912 lvi. 915.
Crawford, D G., *Ind. Med. Gaz.*, 1903 and 1906.
Emery D'Este, *Lancet*, 1907 i. 1696.
Fuhs, *Amer Journ. Med. Sci.*, 1911 clxii. 713.
Gibson, A. G., Schorstein Lecture *Lancet*, Oct. 29 1921
Giffen and Sziapka, *Mayo Clinic*, 1920 xii.
Hege, *Med. Rec.*, Sept., 1895, and *Ann. of Surg.*, 1897 vol. xxv
Johnston, G. B., *Ann. of Surg.*, July 1908, p. 50.
Jonnesco, *Gaz. des Hôp.*, Oct. 27 1898.
Lewis, *Amer Journ. of Med. Sci.*, 1908, cxxxvi. 167
Macdonald, I., and **W A. Mackay** *Lancet*, 1909 ii. 917
Maxwell, J P., *Lancet*, 1909, vol. ii.
Morris and Bulloch, *Ann. of Surg.*, 1919 lxx. 513.
Moynihan, Berkeley *The Spleen and Some of its Diseases.* 1921
Osler *Amer Journ. of Med. Sci.*, Oct. 1900 p. 54; *Proc. Roy Soc. of Med* Med. Sect. 1912, vii. 1
Power D Arcy *Clin. Journ.*, Nov 28, 1906, and *St. Bart.'s Hosp. Repts.*, xliv 101
Richards and Day *Brit. Journ. Surg* 1914, vol. iii., No. 3.
Sajous, *Internal Secretions*, 8th Edit., 1919.
Sendler "Traumatic Splenic Abscess," *Deuts. Zeitschr f Chir.*, 1893, Bd xxxvi., Heft 5.
Sippey *Amer Journ. of Med. Sci.*, 1899, pp. 428, 570.
Thursfield and Gow *St. Bartholomew's Hosp. Repts.*, 1914, vol. 50 pt. 1
Vanverts, *De la Splénectomie*, Thèse de Paris 1897
Warren, Collins, *Ann. of Surg.*, May 1901.
Warthin, *Contributions to Medical Research*, p. 234. 1903.

MALFORMATIONS OF THE FACE, LIPS, AND PALATE

By CYRIL A. R. NITCH, M.S., F.R.C.S.

Development of the face and lips.—At a very early stage of development the stomodæum appears as a depression between the yolk-sac and the anterior extremity of the embryo. The depression becomes deepened by the outgrowth of the heart immediately

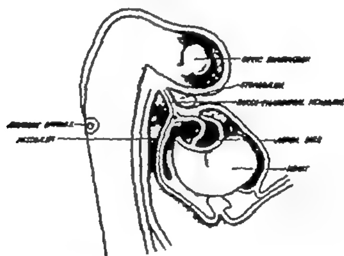


Fig. 292.—Reconstruction of the anterior portion of an embryo of 2·15 mm.

(After His and McMurrich.)

below it, and by the ventral bend that takes place at the anterior extremity of the brain, until its floor lined by ectoderm comes in contact with the entoderm of the mesodæum. These two layers are known as the bucco-pharyngeal membrane (Fig. 292). They fuse together, atrophy, and disappear, so that by the end of the third week the stomodæum and mesodæum are continuous with one another. During

the same week, five processes—one mesial (the fronto-nasal) and four lateral (the two maxillary and the two mandibular)—bud out from the base of the primitive cerebral capsule around the margins of the stomodæum and, by their growth and ultimate coalescence, enclose the cavity which is now termed the oro-nasal cavity and complete the facial portion of the head at the end of the second month (Fig 293)

The mesial or fronto-nasal process which bounds the upper part of the oro-nasal cavity becomes elevated on either side of the mid line to form two marked protuberances, the globular processes.

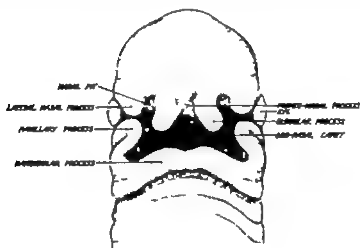


Fig. 293.—Face of an embryo of 8 mm.
(*After His and McMurrich.*)

Simultaneously with the formation of the globular processes, two oval depressions or grooves, the nasal pits, appear externally to them, and thus separate the lower end of the fronto-nasal process into three parts—a mesial nasal process with its globular processes, and two lateral nasal processes.

These processes are in reality the anterior extremities of three vertical septa that grow down from the base of the primitive cerebral capsule they are kept apart by the gradual deepening of the nasal pits, and ultimately form the septal and lateral walls of the nasal cavities. The portion of the mesial nasal process which intervenes between the two globular processes is divided into an upper triangular and a lower quadrilateral area by a transverse ridge which later becomes moulded into the tip of the nose. The upper triangular area becomes the dorsum of the nose, the lower quadrilateral portion

the columella i e the septum between the anterior nares. By the elevation of this median portion to form the external nasal organ the globular processes are enabled to fuse together to form the middle third of the upper lip (philtrum) and the premaxilla. Imperfect union in this situation leads to that rare malformation median hare lip While these changes are taking place above the mandibular processes below have united (in the fifth week) to form the mandible lower lip and chin. All that is now required to complete the face

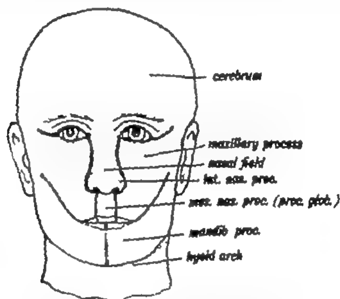


Fig. 294.—Showing the parts of the face formed from the nasal, maxillary, and mandibular processes.

(From Keith Human Embryology and Morphology)

is the closure of the gap between the mandibular bars and the lateral nasal and fronto-nasal processes.

This is effected by a bud-like projection known as the maxillary process, which springs from the upper border of the base of the mandibular bar on each side, and sweeps inwards and forwards beneath the eye and the nasal groove, thereby separating them from the oral cavity Above, it blends with the lateral nasal process to complete the ala of the nose anteriorly with the globular process to complete the upper lip and below with the mandibular bar to diminish the size of the oral aperture. Therefore failure of union between the maxillary and either of these three processes results in facial cleft, lateral hare lip or macrostoma. (Fig 294.) Conversely fusion of the maxillary and mandibular processes beyond the normal degree leads to microstoma.

Development of the palate.—If the interior of the oro-nasal cavity be examined in a foetus of seven weeks (Fig 295) the olfactory chambers will be seen opening into it by the primitive *choanæ*, between *the maxillary processes and the shelf like projection* from the posterior part of the mesal nasal (globular) process in which the premaxilla is developed. Laterally two horizontal plates will be noticed springing from the inner aspect of the maxillary processes These, the palatal plates, grow inwards beneath the nasal septum, and, fusing from before backwards, first with the premaxilla, and later with each other complete the hard and soft palates and separate

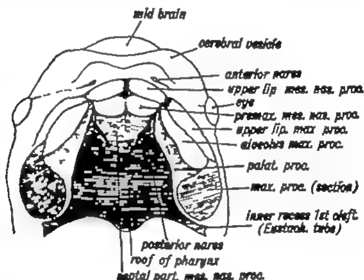


Fig. 295 —Showing the ingrowth of the palatal plates of the two maxillary processes early in the second month. The openings erroneously indicated as posterior nares are the primitive choanæ. (*After Kollmann*)

(*From Keith Human Embryology and Morphology*)

the nose from the mouth. From this it will be understood that partial cleft palate *is due to defective fusion of the palatal processes* with each other that complete cleft palate follows non union of a palatal plate with the premaxillary process in front and the opposite palatal plate behind and that in complete cleft palate and hare-lip the cleft lies between the maxillary and palatine processes externally and the globular premaxillary and opposite palatine processes mesially As the process of fusion spreads from before backwards, partial cleft palate occurs with greater frequency than complete cleft palate, and a complete cleft is not always accompanied by hare-lip Similarly partial or complete hare-lip is not

necessarily associated with cleft palate for as Fig 293 clearly shows, the upper lip is completed by the union of the maxillary and mesial nasal (globular) processes, whilst the palate is fashioned from the three horizontal plates which grow inwards from these processes.

The fœtal palate has a very high arch, for the palatal plates develop in an upward as well as a horizontal direction, in the endeavour as it were, to meet the nasal septum, with which they eventually fuse This peculiarity of growth accounts for the frequent combination of a high arch with cleft palate and in such cases is of great value to the surgeon if a "flap-sliding" operation is undertaken for when the flaps are separated from the bone, they fall into a horizontal plane and so naturally approach one another

Fig 296.—Showing the hard palate at birth. The premaxillary part is formed from the mesial nasal processes the remainder by the palatal plates of the maxillary processes.

(From Keith "Human Embryology and Morphology.")

Development of the premaxilla.—The premaxillary bones are ossified from two centres which appear side by side in the premaxillary process on the deep aspect of the mesial nasal (globular) process later these bifurcate and give origin to the four incisor bones. (Fig 296) As a rule, all four upper incisor teeth are developed on this process, each bone forming the socket for one tooth but, according to Keith, the lateral incisor may occasionally appear on that part of the alveolus which is developed from the maxillary process.

In the majority of mammals the premaxilla is highly developed and forms the prognathion or snout. This characteristic is well simulated in the infant in those cases in which a cleft in the hard palate bifurcates at the naso-palatine foramen into two branches, that pass forwards and outwards between the premaxillary and

palatine processes. In such cases the premaxilla, having no lateral attachments to fix it is pushed forward by the palatine processes as they approach each other and at the same time undergoes excessive development from lack of restraint (*see* Fig 303)

MALFORMATIONS

MACROSTOMA

Macrostoma or buccal cleft is due either to failure of union of the posterior portions of the maxillary and mandibular processes, or after union has taken place, to arrested growth caused by the pressure of amniotic bands. (Fig 297) The condition varies from a slight defect at the angle of the mouth to a cleft which may extend nearly to the auricle though usually bilateral, it may be unilateral, and in either case is not infrequently associated with other congenital defects such as oblique facial cleft and accessory auricles. As usually seen, the defect is limited to a slight increase in the size of the oral aperture, and, beyond its unsightly appearance, gives rise to no inconvenience but in severe cases the constant escape of saliva, and the defective nutrition that results from the inability of the child to retain food in the mouth render an operation imperative.



Fig. 297 —Macrostoma with auricular appendages.

Treatment.—The edges of the cleft should be pared with a sharp scalpel, and then united with an inner muco-mucous layer of catgut and an outer cutaneous layer of fine salmon-gut sutures. The only detail requiring attention is the identification of Stenson's duct before paring the edges of the cleft.

MICROSTOMA

Microstoma, or congenital atresia oris is as its name implies the very reverse of macrostoma. This rare defect is the result of an excessive degree of fusion between the maxillary and mandibular processes, and may take place to such an extent as to leave an opening which will only admit a small probe It must not be confused with acquired stenosis following cicatricial contraction after burns, syphilitic ulceration, lupus etc.

Treatment.—When necessary the oral aperture may be elongated by incising the cheek at the angles of the mouth and suturing the mucous membrane to the skin

FACIAL CLEFT

This is such a rare malformation that a passing reference to it will suffice. As already stated in the account of the development of the face, it is due to partial or total failure of union between the maxillary process below and the lateral nasal and globular processes above. Another and possibly more accurate explanation of the cause of facial, buccal, mandibular and auricular clefts is offered by Ballantyne, who infers that they are due to the presence of amniotic adhesions and bands formed during morbid conditions of development, rather than to defective union of normal elements The cleft, commencing in the red margin of the upper lip just externally to the philtrum, may extend to the middle of the lower eyelid, thence to the outer canthus, and, very rarely into the temporal region. It may be bilateral and asymmetrical, as shown in Fig 298 and usually involves only the soft parts.



Fig 298.—Mandibular cleft and two varieties of facial cleft.

Treatment.—Simple clefts may be closed by suture after paring the edges, but clefts involving the orbit generally require a complicated plastic operation

FISTULA OF THE LIP

The opening of a fistulous track, lined with mucous membrane and directed upwards towards the ala of the nose, is sometimes seen on the red margin of the upper lip close to the philtrum. Its presence is probably due to defective fusion of the soft parts, and serves to emphasize a lucky escape from hare-lip In some instances similar good fortune is shown in a more definite manner by the presence of a well marked groove at the site of union of the globular and maxillary processes. Congenital fistulæ of the lower lip situated on either side of the mid-line have also been described. Their method of formation is obscure.



Fig 299 —H. H. Clutton's case of median hare-lip and cleft alveolus.

(*This and the next two figures are from drawings in the Museum in St. Thomas' Hospital Medical School.*)

Treatment is only required if the fistula gives rise to a copious discharge, or repeatedly becomes inflamed from retention of its secretion. In such a case, one or more applications of the galvano cautery will suffice to close it

MANDIBULAR CLEFT

This defect usually involves both the bone and the soft parts, and is situated in the middle line of the lower jaw at the point where the two mandibular processes should have united (Fig 298) It is the rarest congenital malformation of the face, and seldom occurs alone, being usually associated with various forms of facial cleft, or with a cleft of the tongue and the floor of the mouth.

Treatment.—The cleft may be closed by one of the methods employed in the treatment of hare-lip

HARE-LIP

Hare-lip is the commonest malformation of the face, and according to Stone, occurs in one out of every 2 400 infants. Though isolated

examples occur in families heredity usually plays a powerful part in its causation and in such instances the tendency is generally transmitted by the mother Two anatomical varieties are met with the median and the lateral.

MEDIAN HARE LIP

One of the rarest of malformations in the human being, this occurs as a natural characteristic in the animal from which it derives its name Being due to persistence of the notch between the two globular processes (Fig 293) it can never extend quite to the columella of the nose for this is developed by the elevation of the (mesial) fronto-nasal bud. In the classical example depicted in Figs 299 and 300 it will be seen to involve the lip for a little less than half its depth.



Fig. 300.—Same case as in Fig 299.



Fig. 301 —Median defect of upper lip due to imperfect development of the premaxilla.

True median hare-lip must not be confused with another rare median defect of the upper lip in which the cleft though anatomically median, is embryologically due to a bilateral hare-lip complicated by an entire absence of the lower end of the fronto-nasal process and the premaxillary

bone In such a case the nose is extremely flattened owing to absence of the columella and the lower end of the nasal septum, and for the same reason its alae form the anterior boundary of an oro-nasal cavity (Fig 301)

Treatment.—*In slight cases the defect is readily corrected by* Nélaton's operation (p 152) but when the cleft is at all deep the methods advocated by Rose (p 152) or Mirault (p 153) give the best result.

Lateral Hare Lip

This the most usual form of hare-lip may be unilateral or bilateral, may involve the soft parts only or be complicated by a cleft alveolus or complete cleft palate. The defect is more common in boys than in girls when unilateral it occurs more often on the left side and may be accompanied by cleft alveolus or cleft palate while the bilateral variety rarely occurs without a corresponding cleft in the alveolus and palate. In both varieties the defect varies from a slight indentation in the red margin of the lip to a deep fissure which extends into the nostril.

In the slighter grades a narrow shining strip of skin having the appearance of scar tissue is sometimes seen extending between the apex of the indentation and the nostril. *As microscopical examination* has proved that none of the elements of scar tissue are present in these strips, their appearance can only be accounted for by the disturbance in the normal process of development and by delayed union.



Fig 302.—*Unilateral* complete hare-lip showing forward and outward rotation of the premaxilla and flattening of the ala nasi.

(From a patient at the Evelina Hospital.)

Unilateral, or single hare-lip as it is generally called is unfortunately more often a deep than a shallow cleft, only separated from the nostril by a narrow strip of skin representing the remains of the upper lip When the fissure extends completely into the nostril the alveolus is invariably cleft as well, and not infrequently the defect in it extends backwards into the hard and soft palates.

The margins of the cleft are often unequal in length, and the nostril of the same side is broadened and flattened. When the cleft extends into the nose the flattening is more marked and frequently the outer margin of the fissure is directly

continuous with the ala nasi. The deformity is further increased by the presence of a cleft in the alveolus, for in such cases the inner or premaxillary portion of the bone projects forwards in advance of the outer margin of the cleft and owing to the loss of its lateral attachment looks obliquely upwards and towards the unaffected side the apex of the nose and the root of the columella are carried with it, and the ala nasi forms a flat and almost tense band of tissue bridging over the upper extremity of the cleft (Fig. 302)

Bilateral hare-lip like the unilateral form may be partial or complete, but more often the cleft on one side is partial involving only a portion of the lip, and on the opposite side is total, extending



Fig 303.—Bilateral complete hare lip. The profile shows protrusion and upward rotation of the premaxilla.

through the whole depth of the lip and generally through the alveolus and the hard and soft palates as well. When the clefts are total on both sides and extend to the bone the premaxilla or os incisivum, no longer kept in position by its lateral attachments to the hard palate is pushed forwards and upwards by excessive growth of that part of the nasal septum formed from the premaxillary process and in severe cases projects beyond the tip of the nose giving the child the characteristic prognathous appearance (Fig 303) Frequently the pedicle by which the premaxilla is attached to the nasal septum is so narrow that considerable lateral movement of the process is permitted. The skin and subcutaneous tissue corresponding to the median portion (philtrum) of the upper lip is smaller than usual and possesses no lower free margin, being firmly attached to the subjacent bone and

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blending laterally and below with the mucous membrane enveloping the premaxilla. The nose is flattened, and the antero-posterior length of its columella is shortened in proportion to the degree of projection of the premaxilla The teeth of the premaxilla are liable to many variations from the normal they are generally irregular in position and obliquely directed in the majority of cases only two the central incisors, are present, but occasionally there are four or more

Site of the cleft.—In true median hare-lip the cleft lies between the two globular processes, outgrowths of the mesial nasal process, while in lateral hare-lip it is placed between the globular process on the inner side and the maxillary process on the outer side —not between the globular process and the lateral nasal process, as suggested by Albrecht, for it is now well known that the latter process takes no part in the formation of the lip The much-discussed position of the cleft in the alveolus is described under Cleft Palate (p 160)

Treatment of Hare-Lip

Obviously the only method of treating such an unsightly defect is by an operative procedure, having for its object the closure of the cleft and the restoration of the red margin of the lip The only detail on which opinions have differed is the **age at which the operation should be performed** This depends to a certain extent (1) upon the size and nature of the defect and the condition of the child, and (2) upon the skill of the operator the rapidity with which he works, and his familiarity with the method he proposes to employ No surgeon should approach the task in a light hearted manner for no matter how slight the defect, its accurate closure requires a certain degree of skill only to be acquired by practice, as the tyro will readily confess when he sees the result of his work, six months or a year later Speaking generally the best time for operation is during the *second month*, for by then the infant has become accustomed to its nurse, is familiar with its surroundings, sleeps for the greater part of the day and, in the event of the size of the cleft or the condition of the mother having rendered bottle- or spoon feeding necessary should be free from gastro-intestinal disturbances. But if the child is undeveloped or badly nourished the operation must be postponed until the patient's condition has materially improved for the mere remedying of the defect at an early age is unlikely to have a marked effect upon its general health.

In *slight* cases the child can generally suckle without difficulty so that if the mother can nurse it properly it is wiser to defer the operation until the time for weaning arrives. When the cleft is

large natural feeding can and should be carried out by means of a glass nipple-shield to which is fitted a large rubber teat that fills the gap in the lip. After the operation the child should still be fed with maternal milk, drawn off with a pump, until such time as it can be put to the breast again.

In cases of *bilateral cleft* natural feeding is, of course, impossible. In such circumstances the child must be spoon fed and operated upon as soon as the surgeon judges that its condition will permit after wards it can be brought up on the bottle in the usual manner Another reason for operating on bilateral hare-lip at an early age is the urgent necessity of replacing the premaxilla and counteracting its forward growth by the pressure which is brought to bear upon it by the united lip It is surprising what a marked effect this procedure has in inhibiting the prognathic tendency especially if the mother or nurse be instructed to assist it by frequently and regularly applying pressure until the protrusion is reduced.

When hare-lip coexists with cleft palate and when the early operation upon the palate (Lane's or Brophy's) is contemplated the closure of the gap in the lip must be deferred until healing of the palate is complete. As the ultimate appearance of the lip will depend in great measure upon the neatness of the scar it is of the utmost importance that primary union should be secured. In order to attain this desirable end, no operation should be undertaken until the child is in a satisfactory state of health and the mouth, the nose, and the aural cavities have been examined and found to be free from any infective condition.

Preparation for the operation.—When the surgeon has to deal with a healthy well-nourished infant, no special preparation is necessary other than the administration of a small dose of castor oil two days beforehand in fact, the less the normal routine and surroundings of the child are disturbed, the better it will bear the operation But when the infant is peevish, ill nourished, and the subject of gastro-intestinal catarrh from improper feeding the operation may have to be delayed for a month or longer If the child is being suckled and does not thrive as well as it should do it must either be weaned at once or its nourishment augmented by two or more bottle-feeds daily Though the quality and quantity of a feed must be varied to a slight extent for different babies the following formula is a very useful one on which to base its composition —

At two months

Milk	℥i½
Whey	℥i½
Cream	℥i
Sugar	1 eggspoonful

The addition of cream is important as a fattening agent, and Barbadoes sugar is preferable to the Demerara or crystallized variety on account of its better laxative properties. The milk should be sterilized or pasteurized as a routine, for it is practically impossible to obtain bacteriologically pure milk, no matter how healthy the cow or how carefully the milk is collected and conveyed. The addition of sodium citrate in the proportion of one grain to the ounce of milk, is often of great assistance in diminishing the size of the curd and rendering the milk more digestible. Patent foods and tinned milks should never be given. The child's condition can always be greatly improved by daily inunction with cod liver oil after a warm bath, the unpleasant odour and greasy nature of the oil being compensated for by its beneficial effect. The room in which the operation is performed should be well heated, and the infant should be well wrapped up. Young babies being *very susceptible to shock, every precaution should be* taken to guard against it

Position of the patient.—The position of the infant during operation depends mainly on the individual habit of the operator some prefer the upright position the child then being wrapped in a blanket, with the arms and legs secured and seated on a firm cushion placed upon the nurse's lap others go to the opposite extreme and favour the supine position with the head hanging over the end of the table. As a matter of fact, any position will do provided it be so arranged that blood cannot trickle into the pharynx. Perhaps the most satisfactory position is a semi reclining one, with the head tilted to one side and steadied by an assistant so that blood can readily escape and the surgeon can obtain a good view of the lip

The operation.—In order to avoid repetition, the general principles of the operation will be described first, and later a few of the most useful and practical methods of closing the defect will be given. For a full account of the numerous methods and modifications that have been suggested and employed the reader is referred to a manual of operative surgery

The choice of the anæsthetic naturally depends upon the anæsthetist, but, as a general rule chloroform, given on a mask to commence with, and continued with a Junker's inhaler is very satisfactory provided that special care be taken not to push the anæsthesia beyond the "contracted-pupil" stage. The operation should never be performed without an anæsthetic. Before it is begun, the nose and mouth should be cleared of mucus, and the lips washed with ether soap

The main principles that underlie a successful and ornamental issue are (1) the free liberation of the lip, the cheek, the ala of the nose, and occasionally of its columella, from the underlying bone (2) the shaping of the nostril (3) the paring of the margins of the

cleft or the cutting of a good-sized flap or flaps (4) the accurate suturing of the raw surfaces.

1 The *free liberation of the lip* is the first and most important step in the operation, for unless this be thoroughly and systematically carried out coaptation without tension will be impossible In unilateral cases the lip on the outer side of the cleft should be raised with the fingers, and the mucous membrane divided with a sharp knife at its junction with the gum. The handle of the scalpel is then used to detach the lip and cheek from the bone, care being taken to stop the dissection short of the infra-orbital foramen lest the infra orbital nerve be damaged. If the ala of the nose is flattened in the slightest degree, it must be freed from the subjacent bone at the same time. Provided the tissues are torn and not cut from the maxilla the hæmorrhage is very slight and can easily be controlled by pressure When the outer portion of the lip has been sufficiently mobilized, the inner margin and the columella of the nose, if at all displaced, are freed in a similar manner

2. The next step consists in so *shaping the nostril* as to make it harmonize with that of the opposite side. Needless to say this is only necessary when the hare-lip is a complete one as the contour of the nose is seldom altered in the partial variety To commence with, a straight, sharp needle threaded with a salmon-gut suture is entered at the lower end of the naso-labial groove, and carried inwards and downwards to emerge at the junction of the nostril with the outer margin of the cleft. It is then passed in an upward direction from the inner margin of the cleft, through the base of the nasal septum into the opposite nostril. The parts are now approximated, and if the deformity has been properly corrected, the ends of the suture are secured with split shot after the edges of the lip have been pared In many cases this simple procedure produces the desired result, but occasionally the cartilage of the ala becomes so folded upon itself as partially to block the aperture. In such cases a large V-shaped piece may be excised, as depicted in Fig. 304 or a flap of mucous membrane can be turned up and the redundant cartilage removed or a portion of the ala may be excised (by an incision that follows the naso-labial groove) and re-attached to the lip and cheek with a few fine sutures. Though the rectification of the ala nasi appears simple enough in theory in practice a perfect result is seldom obtained.



Fig 304. Method of rectifying infolded ala by excision of V shaped piece of mucous membrane and cartilage.

3. The *paring of the margins of the cleft* or the *shaping of flaps* is accomplished with a pointed sharp narrow bladed scalpel, in

preference to a tenotome, which is either unduly pliant or unnecessarily thick in the back. The red border of the lip being seized with fine rat-tooth forceps at the point where its horizontal portion merges into the vertical border of the cleft, the scalpel is entered exactly at the junction of the skin and mucous membrane, plunged through the whole thickness of the lip and carried with a gentle sawing motion upwards towards the nostril, or even into it if necessary The incision should be kept just external to the vermilion border of the lip and should never be allowed to encroach upon it, otherwise when the operation is completed the result will be marred by the presence of a patch of red mucous membrane in the line of the scar

If the operator intends to turn down two flaps of mucous membrane, as in Fig 306 it is of the utmost importance that the incision, at its lower end should lie exactly between the mucous membrane and the skin, otherwise the vermilion border of the lip will be interrupted by a white line formed by the included skin. In some cases it may be necessary to deepen the lip This is accomplished by curving the upper part of the incision outwards well into the skin, so that the raw surface presents a concavity towards the cleft, as in Fig 306 but at its lower extremity it must still follow the junction of the mucous membrane and the skin, or the unsightly patch of skin will again appear in the vermilion border The hæmorrhage that follows division of the coronary arteries in the margin of the lip is controlled temporarily either by an assistant seizing the lip between his fingers or with a pair of narrow bladed artery forceps, and permanently when the sutures are inserted.

In cases of bilateral hare-lip the alæ nasi and the lips are thoroughly freed, and the edges of the latter denuded or shaped into flaps in the manner already described. The suture that was employed for restoring the shape of the nostril in the unilateral case should perforate the base of the nasal septum as before, and then be passed through the nostril from within outwards, and made to emerge at a point in the naso-labial groove exactly corresponding to its point of entry on the opposite side. Before cutting the labial flaps, it is advisable to freshen the edges of the skin covering the premaxilla in order to obtain a better idea of the size and thickness of the flaps necessary effectively to close the defect. As it is important to preserve as much of this premaxillary tab of skin as possible and also to shape it in such a way that it will dovetail nicely between the labial flaps, its inferior margin should be cut to resemble a wide V (Fig 312) If the premaxilla is unduly prominent, it should be returned to its normal position at the same time, either by simply pushing it back or if this is not successful, by the operative procedure described later

4 The fourth and last stage of the operation consists in *so suturing the raw surfaces that the edges of the vermilion border are brought into accurate apposition* and form a continuous line. To obtain this desirable end, the first suture should enter the lip exactly at the junction of its red border with the skin on one side, and emerge at a corresponding point on the opposite side When the method of closing the defect depends upon apposition of two inverted flaps, as in Fig 306 it is important to see that they project below the margin of the lip in the form of a well-marked papilla, otherwise the cicatricial contraction that follows healing will leave an unsightly notch in the red margin. The remaining sutures are then passed deeply into the substance of the lip but they must not penetrate the mucous membrane. Finally the whole lip is everted and the mucous membrane on its deep aspect is united by a few fine catgut sutures. Fine silkworm-gut, technically designated ophthalmic, forms the best suture material, being pliant, non irritating, and easily removable. Hare-lip pins are now obsolete.

Dressing the wound.—In ordinary circumstances the wound is better left uncovered, so that it may be frequently and easily cleaned with a damp sponge. The doubtful advantages that accrue from the use of a strip of gauze, soaked in collodion or Whitehead's varnish, and fixed by a dumb-bell-shaped piece of strapping so applied as to relieve tension, are neutralised by the ease with which particles of food or mucus from the nose and mouth, collect beneath the dressing and infect the wound. Before the child leaves the operating table the depression beneath the lower lip should be well painted with thick collodion. This, by contracting as it dries, produces an amount of eversion of the lip just sufficient to leave an airway into the mouth and so minimise the danger of asphyxiation, for immediately after closing the cleft, the upper lip is somewhat tightly stretched across the alveolus possesses little if any movement, and by the increase in its depth (i.e. height) is in close contact with the floppy redundant lower lip, which is sucked against it at every inspiration until consciousness returns.

After treatment.—For the first few days after the operation the child must be nursed and coaxed as much as possible in order to reduce the amount of its crying to a minimum, otherwise some or possibly all of the sutures may tear out. In the event of such a catastrophe, the surgeon must wait until the raw surfaces are covered with healthy granulations, when the edges should be freshened with a sharp scalpel and re-sutured. Feeding is best carried out with a small spoon or a drinking-cup provided with a long piece of india rubber tubing, until such time as the child can be put to the breast again. In cases of incomplete cleft of slight degree this may be

permissible in three or four days, but in the severer grades eight to ten days must elapse before suckling can be allowed with safety The stitches should be taken out on the fifth or sixth day When removing stitches it is always advisable to stupefy the child with chloroform, lest a sudden movement or a violent fit of crying make the wound gape.

Operations for Single Hare-Lip

Nélaton s operation —As a primary operation this method is only applicable to defects of very limited extent, and for this reason can seldom be employed. It is more often of value in correcting an indentation of the lip, the result of cicatricial contraction after some other form of operation (Fig. 305)

An inverted V-shaped incision is made through the whole thickness

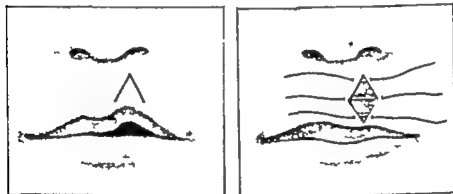


Fig 305.—Nélaton s operation

of the lip above and around the margin of the cleft. The skin and mucous membrane is then pulled downwards until the wound becomes diamond-shaped, when its edges are approximated with a few horizontally placed sutures.

Rose s operation —As this method yields good results only when the two sides of the cleft are more or less symmetrical, its application is somewhat limited. It is described here because it illustrates two of the points that were emphasized in discussing the operative procedure in general, viz. (1) that the height of the lip may be increased by curving the vertical incisions outwards, and (2) that the incisions forming the flaps must be placed exactly between the skin and the red border of the lip

Two curved incisions with their concavities directed towards each other are carried from the apex of the cleft to the junction of the skin and the red border of the lip, on each side of the defect

(Fig 306) The points at which these incisions terminate must be selected with care, for if they are placed too far apart the "Cupid's bow" curve of the lip will be too exaggerated when suturing is completed and if they are too close to the margins of the cleft the red border will be horizontal at the completion of the operation, and notched upwards when cicatricial contraction has taken place. From the termination of the first incision a second incision is carried inwards and upwards exactly between the vermilion border and the skin, to emerge about the middle of the cleft and form two long flaps of mucous membrane. These are everted and when the raw surfaces are sutured a well marked projection is formed at the margin of the lip. If the flaps are too long, the redundant portions can always be removed before suturing is completed

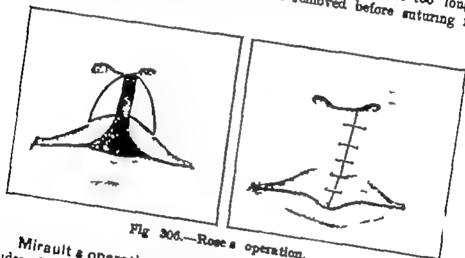


Fig 306.—Rose's operation.

Mirault's operation —This operation is employed when the two sides of the cleft are of unequal length, differently curved, or widely divergent. To obtain a good result a certain degree of mathematical accuracy is required in paring the edge and shaping the flap.

On the more oblique side of the cleft (Fig. 307) a point, A, is selected at, or just below the centre of the curve A represents a point in the normal line of the lip perpendicularly below A C is situated at the junction of the horizontal and vertical borders of the steeper side of the cleft B marks the termination of the flap incision. The distance between B and C must equal the distance between A and A The oblique side of the cleft is pared by the concave incisions D A, E A, leaving a projection at A. On the opposite side, a flap B D C is formed. This is turned down and applied to the raw surface opposite, so that the projection at A fits into the angle formed at B. The redundant tissue at the apex







Fig. 307 —Stages of Mirault's operation. (For references, see text.)

of the flap B D C is removed by an oblique incision so placed that the edges of the red border come into accurate apposition. This incision should not be made until *the flap has* been laid in position.

Edmund Owen's operation, though *resembling that of Mirault* to a certain extent, differs from it materially in that the flap which is brought across the fissure is large and fleshy instead of thin and attenuated. The method is particularly applicable to the closure of large and deep clefts with asymmetrical sides, and in good hands gives most excellent results.

The mucous membrane on the smaller side of the cleft and lip is removed nearly as far as the angle of the mouth (Fig 308) On the opposite side a large flap is cut, with its apex at the top of the cleft. The incision by which this flap is formed is, near its extremity carried parallel to the normal line of the lip for a short distance, so as to diminish the tendency to puckering that takes place at this point when the sutures are inserted. The large flap thus formed is then turned down forming the mucous

the past, and doubtless will continue to do so in the future. When the prognathion is ill developed, obliquely directed and rotated forwards at a right angle to the alveolar margin there can be no two opinions as to the best course to pursue it should be resected, but the tab of skin covering it should not be sacrificed, for small though it may be, it will be of use in the reconstruction either of the columella or of the lip. On the other hand, when the premaxilla is well shaped, firmly attached, and only slightly in advance of the alveolar margin, it should be preserved and utilized in closing the defect, for the very fact of attaching the margins of the cleft to it will prevent its becoming prominent, and if the operation be performed within the first two months of life, may even lead to its recession between the maxillæ. It is in the intermediate type of this deformity when it becomes necessary to fracture the vomer before the premaxilla can be replaced that the difficulty in deciding upon the best line of treatment arises. If the premaxilla is preserved its pedicle must be divided before it can be forced into position, and the mobility thus acquired may persist in after life, rendering it useless for mastication, and a continual source of annoyance to its possessor. Again, as the bone is replaced by rotating it through the arc of a circle the centre of which is at the seat of fracture of the pedicle, the incisor teeth, apart from their tendency to erupt irregularly may also point backwards instead of downwards, and so be worse than useless. On the other hand, if this bone be removed a permanent gap is left in the alveolar margin, and the width and forward curve of the maxillary arch do not fully develop In consequence, the lower jaw projects considerably in advance of the upper the flat, tense, reconstructed upper lip is under hung by the well-developed lower lip and the child starts life with a profile that is as unsightly as it is characteristic (Fig 311) Therefore, taking everything into consideration, it is of the highest importance to preserve this portion of bone whenever possible for there is always the possibility of fibrous union taking place between it and the maxillæ and even if, in spite of this, the bone still remains mobile, it can always be excised after the permanent teeth have developed, and the gap filled in with an obturator fitted by a skilled dental surgeon.



Fig. 311 —Characteristic profile after excision of the premaxilla and suture of the lips. (*Helm*)

Operation for replacement of the premaxilla (von Barde-

leben's modification of Blandin's method) —The muco-periosteum on the free edge of the nasal septum is incised in an antero-posterior direction about half an inch behind the premaxilla The length of the incision corresponds to the distance that the premaxilla projects beyond the alveolus. The muco-periosteum is then freely separated from each side of the vomer and the bone divided by a vertical cut made with a pair of scissors. The premaxilla can now be pushed back with ease and if necessary trimmed until it fits into the cleft. Though it is maintained in position by the plastic operation that is immediately performed upon the lip it is sometimes

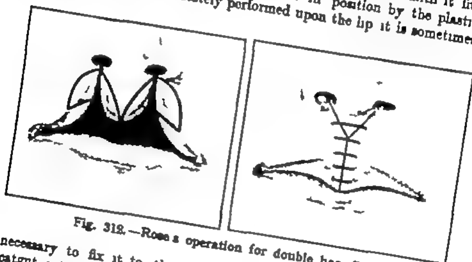


Fig. 312.—Rose's operation for double hare-lip

necessary to fix it to the maxillæ with a couple of chromicized catgut sutures.

Operations for bilateral hare-lip *Rose's method* —When the premaxillary bone is in proper position, the skin over it is freed and pared laterally to resemble the letter V Flaps are then cut from each margin of the cleft, inverted, and sutured above to the premaxillary skin and below to each other as depicted in Fig. 312 In most cases this method yields an excellent cosmetic result but if the upper lip is shallow and skimpy or the clefts are very wide Hagedorn's method is more suitable

Hagedorn's method —After freshening the edges of the skin over the premaxilla as in Fig 313 a flap is cut by the incisions 4 3 2, 3 from the outer margin of the cleft on each side, with its base at the junction of the horizontal and vertical portions of the vermilion border These two flaps are everted, and pulled upon so as to straighten them out An incision 1 *a* is now made downwards and outwards into the lip commencing a short distance above the level of the lateral angle *a* on the premaxillary tab of skin This incision when opened up, gives additional height to the lip and, when the

parts are approximated, receives the angular projection *a*. When the suturing is completed as far as the vermilion border the redundant portions of the flaps are removed, care being taken to leave a projection long enough to compensate for cicatricial contraction.

Summary of the choice of operation.—As no one operation is applicable to every variety of hare-lip and as every exponent of this particular branch of surgery is naturally biased in favour of the methods with which he himself has obtained the best results, the following indications, made with due regard to these facts, are given as suggestions rather than as a series of rules —

1 *Unilateral hare-lip* —For partial clefts with equal sides, employ Rose's method for partial clefts with unequal sides, Mirault's method and for complete clefts, Edmund Owen's method.



Fig 313.—Hagedorn's operation for bilateral hare lip. The unshaded part of the margin of the cleft corresponds to the portion of the flap removed when suturing is nearly completed.

2. *Notching of the lip* following any of the above operations may be remedied by Nélaton's operation.

3. *Bilateral hare-lip* —For narrow clefts, or clefts with a large premaxilla employ Rose's method. For wide clefts, with uneven sides and a small premaxilla, employ Hagedorn's method.

CLEFT PALATE

Varieties.—Clinically two varieties of cleft palate are recognized—*partial*, in which the cleft is limited to a portion or the whole of the soft palate or to the soft palate and a portion of the hard palate and *total*, when the defect extends through the alveolus as well as through the hard and soft palates. The latter form is frequently complicated by unilateral or bilateral hare-lip.

Anatomically the different varieties are classified with greater accuracy as follows —

1 *Tripartite palate.*—The three palatal elements are widely separated by an elongated Y-shaped fissure, the limbs of which meet at the posterior inferior angle of the nasal septum (Fig 314) In this variety the central element is formed by the premaxilla and the

lower margin of the nasal septum, and the lateral elements by the alveolar margin the hard palate, and the soft palate Tripartite palate is generally complicated by complete bilateral hare lip and excessive protrusion of the premaxilla

2. *Bipartite palate*.—In this variety owing to the union of the premaxilla with the maxilla on one side the cleft is single and lies between the premaxilla and the opposite maxilla extending from the alveolus to the naso-palatine foramen and posterior to this (in

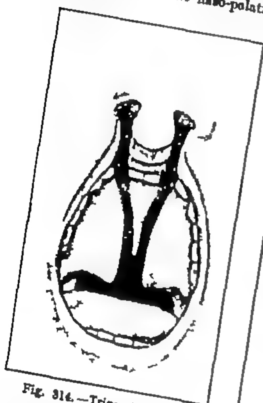


Fig. 314.—Tripartite palate.

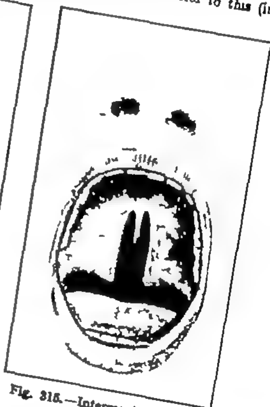


Fig. 315.—Intermaxillary cleft.

the middle line) between the two halves of the hard and soft palates (Fig. 316) Theoretically the cleft should bend outwards in its course between the naso-palatine foramen and the alveolar margin, but as a matter of fact the divergence from the mid-line is very slight, as the premaxillary portion of the alveolar arch is always rotated forwards, upwards, and away from the cleft. The maxillary element with which the premaxilla fails to unite is usually the left one but why this should be no satisfactory explanation is forthcoming The nasal septum instead of being free as in the tripartite palate is generally adherent for a part or the whole of its length to the right

margin of the cleft, and in such cases is also sharply deflected towards the left.

3 *Intermaxillary cleft.*—As this form of cleft is due to failure of union between the palatal plates, it is situated in the middle line, involves either the soft palate alone or both soft and hard palates, and never extends farther forwards than the naso-palatine foramen (Fig. 316) Though the nasal septum may be free, it is more often attached to the right margin of the cleft, as in the bipartite palate.



Fig 316.—Bipartite palate. The nasal septum is adherent to the right margin of the cleft, and is sharply deflected to the left, forming a well marked "spur" (*From case at the Evelina Hospital.*)

4. *Premaxillary clefts*—One variety of this malformation is due to arrested union between the premaxilla and the maxilla. The cleft extends from the alveolar margin to the naso palatine foramen posterior to this, the hard and soft palates are complete and well formed. The cleft, though generally unilateral, may be bilateral The second variety a very rare one is associated with median hare-lip the cleft lying in the middle line between the two halves of the premaxilla. (See Fig 300) The third form is rather a gap in the lip and palate than a cleft, for it is due to suppression of the globular processes from which the philtrum of the lip and the two halves of the premaxilla are developed. (See Fig. 301)

Line of the cleft, and relationship to it of the incisor teeth.—Because clinicians repeatedly pointed out that the cleft is usually situated between the mesial and lateral incisor teeth, Albrecht formulated the theory that each half of the premaxilla is developed in two parts—the mesial, with the central incisor from the mesial nasal process and the lateral, with the lateral incisor from the lateral nasal process. Consequently he and many others believed that the line of cleavage passes between these two portions of the premaxilla and not between the premaxilla and the maxilla The presence of a separate incisive bone for each tooth strengthened this theory However Kölliker and His have conclusively proved that the lateral nasal process takes no part in the formation of either the premaxilla or the lip and that though an incisive bone for each tooth is found, these bones are not developed separately but are formed by cleavage of the single ossific centre in

each half of the premaxilla long after the cleft formation in the palate has taken place. (*See* under Development of the Premaxilla p 139) Consequently it is now generally acknowledged that the cleft passes between the premaxilla and the maxilla or in other words, is meso-exognathic. The varying relationship of the incisor teeth to the margins of the cleft is thus lucidly explained by Keith The germ of the lateral incisor although carried by the mesial nasal process, is laid down in the cleft between the maxillary and premaxillary

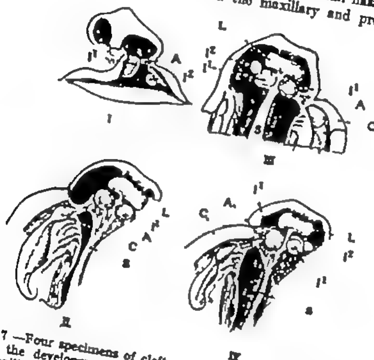


Fig. 317 —Four specimens of cleft palate, showing various degrees in the development of the bond between the premaxillary maxillary and lateral nasal processes.

A, The band or bridge of tissue crossing the cleft; I 1 central incisor sac; I 2 lateral incisor sac C, canine sac L, median part of upper lip S, septum of nose.

(*From Keith* "*Congenital Malformations of the Palate*")

(mesial-nasal) processes. In cases of cleft palate the processes move apart under the strain of growth during the middle and later months of fœtal life Three fates may then overtake the bud of the lateral incisor it may be destroyed, it may remain attached to the premaxillary process, but more frequently it moves outwards attached to the maxillary process. I have seen it stranded on the bridge of tissue between the processes, or loosely attached at one side of the fissure or the other (Fig 317)

Symptoms.—In early life the patient is often quite unable to

suck owing to its inability to create a vacuum in the mouth, while the attempt to swallow fluids is followed by their regurgitation and escape through the nose. During the early months, death may take place from malnutrition and in addition there exists, at all ages, a very real danger from inflammation of the mucous membranes caused by the lodgment and decomposition of secretions and foodstuffs in the oro-nasal cavities These inflammatory changes may set up chronic nasal catarrh, chronic pharyngitis, œdema of the mucous membrane of the Eustachian tubes and subsequent deafness gastro-intestinal disturbances, bronchitis and pneumonia

As age advances, the difficulties of deglutition persist and when speech commences it is imperfect, indistinct, and nasal in tone.

The act of phonation is in reality an exceedingly complicated process, demanding for its proper performance a sounding-box that can be rendered air tight, and a compressing force. The sounding box is formed by the bony walls of the buccal cavity the escape of air from it is prevented by the closure of the lips and the elevation of the soft palate and its shape is altered by the movement of the tongue and cheeks. The compressing force comes from the chest. The presence of a cleft in the palate has little effect upon the vowel sounds, as in enunciating them some of the expired air is normally allowed to pass through the nose, but it interferes greatly with the pronunciation of the majority of consonants, for their production depends upon the complete closure of the naso-pharynx, and the more or less sudden escape of compressed air from the buccal cavity through the orifice of the mouth. Thus the letters *D* and *T* are pronounced by allowing the compressed air to escape with an explosive effect through an opening between the tip of the tongue and the anterior part of the hard palate the sibilant *S* is sounded by forcing air through a chink between the tongue and the palate just behind the incisor teeth In normal circumstances the naso-pharynx is separated from the oral pharynx during phonation by the elevation of the soft palate until it comes in contact with a ridge of tissue, the ridge of Passavant, formed on the posterior and lateral walls of the pharynx by the contraction of the superior constrictor muscles. When the palate is cleft thus closure cannot be effected, so that labial, lingual and palatal consonants such as *P D T S G* and *K* cannot be pronounced. The subject of the defect is by long practice frequently able to overcome a few of these difficulties by forming some of the closed sounds in the larynx and by making others in a different part of the mouth. In this he is often materially assisted by the presence of hypertrophied turbinate bones and adenoids which offer an obstacle to the escape of air through the nose and in the latter case also add to the projection formed by the ridge of Passavant.

TREATMENT OF CLEFT PALATE

The number of cases in which the partial or total closure of the cleft by suture cannot be attempted must be very small indeed but occasionally the surgeon meets with one in which the gap is so wide and the available tissue so scanty either as a result of the magnitude of the deformity or of cicatricial contraction after an operation that has failed, that he has to consider seriously the advisability of having a suitable obturator fitted rather than subject the child to an operative procedure which, from the nature of the cleft or of the tissues bounding it, is doomed to failure from the outset.

Though the use of an obturator gives the best result in connexion with a cleft in the hard palate only its employment for this defect alone is seldom required, for such clefts can nearly always be closed by operation. Except in rare cases, when any means are justified in securing an improvement in phonation and deglutition mechanical devices should only be used as a complement to surgical treatment.

Age at which the operation should be performed—This important consideration has been and still is the subject of much argument Surgeons experienced in the treatment of cleft palate may be divided into two classes those who favour operation within the first three months of life and those who defer treatment until the second or third year In discussing the advantages and disadvantages of the early and late operations, it should always be remembered that the cleft is but one manifestation of a developmental error that has involved not only the soft parts but also the bony walls of the oral and nasal cavities so that the mechanical closure of the cleft at an early age no matter how perfect it be, seldom confers upon the patient a normal speaking apparatus. The same consideration applies to the late operation, for the child who passes the first few years of his life with a cleft palate cannot be taught to articulate clearly and when the defect is remedied his speech is so little better that the phonetic lesson must be commenced all over again

The advocates of the early operation close the cleft by the methods of Arbuthnot Lane or Brophy those who favour the late operation employ Langenbeck's method.

In order to obtain the best phonetic result, two factors are essential (1) that the soft palate should be long, well formed, and freely movable, and (2) that the child should not have learned to talk before the closure of the cleft is brought about. Brophy's method is the only one that fulfils both these requirements. Unfortunately the operation is a severe one, is only applicable in selected cases, and in some unsuccessful ones has been followed by extensive necrosis of the maxillæ and sloughing of the soft parts.

It is owing to the danger of necrosis that this ingenious operation has not received more general support among English surgeons. Arbuthnot Lane's method complies with one of the essentials, in that the cleft is closed long before the child commences to talk but, owing to the extensive flaps that must be fashioned the resulting soft palate is often short and seldom mobile, and phonation suffers in consequence. Similarly Langenbeck's method fails in one of the necessary requirements, inasmuch as it can seldom be performed until after speech has commenced but it undoubtedly possesses the great advantage of leaving the patient with a well-shaped, freely movable soft palate, which, so far as the phonetic result of the operation is concerned is an absolute necessity

To overcome the shortening of the soft palate which follows all the above methods, Gillies and Fry have recently advocated closure of the hard palate with a removable dental plate in earliest infancy followed by elongation and suture of the soft palate alone before speech commences. The claims made for this procedure are (1) a mobile, muscular soft palate long enough to reach the posterior pharyngeal wall (2) normal occlusion of normally placed teeth and (3) well-developed nasal passages. As the writer has no experience of the method he can only thus briefly refer to it it is illustrated in Fig. 332. For further information the reader should consult the original paper (see Bibliography p 174)

Taking these various facts into consideration, the writer's opinion is that *Langenbeck's operation, performed between the ages of* 18 *months and* 2 *years* or earlier if the size of the cleft and the thickness of the tissues permit, gives the best result in the majority of cases. The operation should always be followed by lessons in phonation from a competent instructor Coexisting hare-lip should be operated upon at the age of three months When Lane's method is employed, however the treatment of the defect in the lip should invariably be deferred until some weeks after the palate has been successfully closed

Preparation of the patient.—Having ascertained that the child is in perfect health that its mouth is clean, and that its teeth (if present) are sound it should be placed at least a week before operation under the care of the nurse who is to look after it, so that it may become familiar with its surroundings and have any irregularities in its diet corrected During this time the mouth should be sprayed daily after food, to accustom the child to the after treatment. If the bowels are acting regularly there is no necessity to upset the child by administering an aperient, but if there be constipation a small dose of castor oil should be given twenty four hours before operating When the time comes, the child should be warmly wrapped up and

placed upon a warm- (not a hot) water pillow on a high table with its head hanging over the edge so that the operator who is seated may obtain a good view of the palate. The mouth is kept open with two of Lane's spring gags, one on each side and the tongue is drawn forwards by a suture passing through its tip.

During the operation, sterilized marine sponges being soft and highly absorbent are preferable to woollen swabs for mopping up the blood and saliva. The only special instruments required are two pairs of long dissecting forceps, one toothed and one plain one stout narrow bladed scalpel one cleft palate knife with a long thin handle, a narrow pointed blade and a cutting edge not more than a quarter of an inch in length two pairs of curved and bent elevators a pair of rectangular scissors and Lane's needle-holder and cleft palate needles. In addition to the foregoing, there are required for Brophy's operation a pair of large curved needles on strong shafts, shaped somewhat like the needles employed in the repair of a ruptured perineum.

Early operation for cleft palate.—The *advantages* of the early operation are—

1. The young infant, with few exceptions, is healthy
2. Its digestion has not been impaired by experimental feeding.
3. Repair of its tissues takes place with great rapidity
4. The absence of teeth renders its mouth free from pathogenic and putrefactive micro-organisms, and so minimizes the danger of sloughing
5. The absence of teeth also permits of the fashioning of large flaps.
6. Hæmorrhage is very slight, and the vessels, being so small, seldom require ligation.
7. The baby seldom vomits after the anæsthetic, and takes its food with gusto within a few hours of the completion of the operation
8. It generally sleeps for the greater part of the day

The *disadvantages* are—

1. The field of operation is small, and the tissues are very friable
2. The soft palate formed by Lane's method becomes a rigid piece of cicatricial tissue if the muscular layer is encroached on when cutting the flaps.

Brophy's operation.—The performance of this operation is practically impossible after the third month, owing to the ossification of the maxillæ, and, according to its originator is best carried out about the third week. The edges of the cleft are pared and the opposing edges of the bone are freshened in order to make two broad raw surfaces for apposition. The mucous membrane on the outer surface of the

alveoli is then divided along its line of reflection to the cheeks, and two strong silk sutures are passed through the maxillæ (Fig. 318) anterior and posterior to the malar processes. These sutures must pass through the floor of the nose if they are to avoid the germs of the permanent

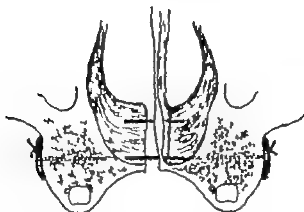


Fig 318.—Brophy's operation: Sutures passed.

teeth they are then tightened over lead plates until the edges of the cleft are in apposition. If this does not suffice to close the cleft, the soft bone is divided with a knife (Fig. 319) or the alveoli are forced together with a special pair of forceps.

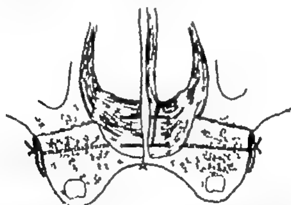


Fig 319.—Brophy's operation Maxillæ forcibly approximated and sutures secured over lead buttons.

Arbuthnot Lane's operation.—As the method now to be described aims at the closure of the cleft by large flaps composed of muco-periosteum in the case of the hard palate, and mucous membrane and submucous tissue in the case of the soft palate, it is essential that it be performed before the milk teeth erupt, or the size of

the flaps will be seriously curtailed. Though Lane advises the performance of the operation within a few days of birth the writer has found by experience that from six weeks to three months is the most suitable age. In spite of the apparent severity of the procedure hemorrhage is inappreciable in amount and there is little if any shock. The cosmetic result even with extensive clefts, is as good as can be desired. There are very few clefts that cannot be closed at one operation, and, what is more important still, the closure is permanent. There is only one place where gaping is liable to occur and that is at the junction of the hard and soft palates, but the aperture is usually so small that it can easily be closed a few weeks later by a simple plastic operation.

General principles of the operation.—The following description is quoted from Arbuthnot Lane's article on the Treatment of Cleft Palate (see Bibliography p. 174) —

"Practically the flap formation employed to close in the hard and soft palates resolves itself into two methods. If the soft parts overlying the edges of the cleft are thick and vascular, a flap is cut from the mucous membrane, submucous tissue, and periosteum of one side, having its attachment or base along the free margin of the cleft. The palatine vascular supply (the great or anterior palatine artery) is divided while the flap is being reflected inwards, and it depends for its blood supply on vessels entering its attached margin. The mucous membrane, submucous tissue, and periosteum are raised from the opposing margin of the cleft by an elevator, an incision being made along the length of the edge of the cleft. The reflected flap, with its scanty supply of blood derived from small vessels in its attached margin, is then placed beneath the elevated flap, the blood supply of which is ample, and it is fixed in position by a double row of sutures. In this way two extensive raw surfaces well supplied with blood and uninfluenced by any tension whatever are retained in accurate apposition. If, on the other hand, the cleft is too broad to admit of its safe and perfect closure in this manner one flap, comprising all the mucous membrane, submucous tissue, and periosteum on one side, is raised, except at the point of entry of the posterior palatine vessels, while the soft parts on the opposite side are raised in a flap from which the posterior palatine supply has been excluded, and which turns on a base formed by the margin of the cleft. Here we have a mobile, well vascularized flap, which can be thrown as a bridge in any direction and can be superimposed on the flap of the opposite side, the closure being necessarily rendered complete by flaps from the edges of a hare-lip. As time goes on, the damage done to the temporary teeth by the separation of the superjacent mucous membrane becomes steadily greater. Still, this is a matter of no moment as compared with the importance of the early closure of the cleft, since the milk teeth are often unsatisfactory in cases of cleft palate, apart from operative interference, while the permanent teeth escape damage from it if undertaken sufficiently early in life."

The application of these methods will now be described briefly for further details the reader must consult the original paper

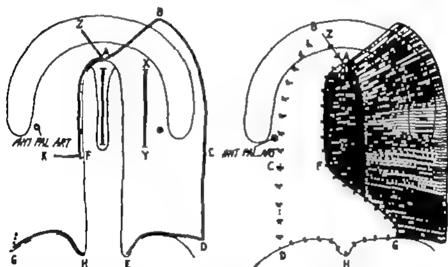
Fig. 320 represents the roof of an infant's mouth with *a broad cleft of nearly the whole palate* in which the nasal septum occupies a median position. The incision A B commences at the anterior limit of the cleft, and runs forwards and outwards across the alveolus to its outer surface. From its termination the incision B O D is made to pass along the outer side of the alveolus, and then through the mucous membrane of the soft palate, to terminate at the anterior pillar of the fauces. From this point, D a third incision is made along the posterior free border of the soft palate as far as the tip of the uvula E. The flap A B O D E thus outlined is dissected up and when reflected will hinge upon the margin of the cleft, A E. The anterior half, A B O, of this flap consists of muco-periosteum. When cutting it, care must be taken not to allow the portion reflected from the alveolus to be too thick. The posterior half, O D E, should consist of mucous membrane and submucous tissue only and should leave the muscles of the soft palate exposed but uninjured. The reader will now readily perceive the advantage that accrues from performing this operation before the teeth erupt for the incision B O can then be made on the *outer* side of the alveolus, and thereby the width of the flap increased by a quarter to half an inch.

On the opposite side of the cleft, an incision A Z, is carried forwards and outwards to terminate on the alveolus, as in the diagram, or beyond it if necessary A second incision A F is then made along the margin of the cleft, and the muco-periosteum between Z, A, and F is raised from the bone. During this procedure due care must be taken to avoid injuring the anterior palatine artery The point of the uvula H, is now seized with toothed forceps and pulled towards the operator so as to expose the upper or *nasal* surface of the soft palate. Along this nasal surface of the soft palate an incision is carried (through the mucous membrane and submucous tissue only) from F the point at which the incision along the margin of the cleft terminated, to G just below the posterior pillar of the fauces. The free edge of the soft palate is then incised from G to H as on the opposite side. The flap F G H, thus marked out, is dissected up with a short bladed scalpel and reflected inwards so as to hinge upon its attached margin, F H, at the border of the cleft. The last step consists in freeing the nasal surface of the soft palate from the posterior margin of the hard palate from F to K. All that now remains is to take the large flap A B O D E, turn it inwards, tuck it under the raised muco-periosteum Z A F in front, and cover it behind with the flap F G H, as in Fig. 321

Sutures are then inserted, as shown in Fig. 321 first along the line B O D uniting the free edge of the reflected flap to the raised flap and to the raw surface on the nasal aspect of the soft palate next, along the line E H G uniting the free edges of the soft palate and lastly a

third row A F G uniting the reflected flap to the free edge of the raised flap, A F and to the edge F G of the flap that has been turned inwards from the nasal surface of the soft palate When the nasal septum occupies the middle line as in Fig 320 the reflected flap may be fixed to it by an additional row of sutures (A Y Fig 321) provided that the mucous membrane is removed from the edge of the septum and from the surface of the reflected flap along the area of apposition. Though this row of sutures is not essential, it constitutes a refinement which gives additional security to and increases the blood supply of, the reflected flap.

The remaining diagrams, illustrating the application of these



Figs. 320 and 321 —Arbuthnot Lane's operation (*see* text).

methods to different varieties of clefts, need but a brief description, as the principles underlying the operations are the same in every case.

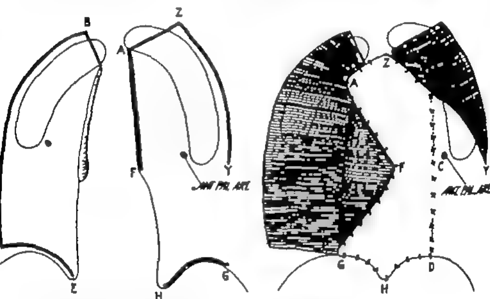
Fig. 322 illustrates *a complete cleft in which the nasal septum is adherent to the right margin*. The reflected flap should always be formed from the side of the cleft to which the septum is adherent, as it obtains an additional supply of blood from the septal vessels at its attached border along the margin of the cleft. If the cleft is very wide, the raised flap F A X can be converted into a mobile flap by continuing the incision from X to Y and bent inwards to cover the large reflected flap (Fig 323) In raising this flap the operator must avoid carrying the dissection too far in a backward direction, or he will divide the anterior palatine artery a vessel that must be preserved

Figs. 324 and 325 represent the method of closing *a cleft in-*

volving the soft palate and a portion of the hard palate. The flap A G H is cut from the nasal surface of the soft palate, and is then reflected inwards and superimposed upon the reflected flap A B C D

Fig 326 depicts a large cleft with a mesial nasal septum. If it be considered impossible to close this at one operation by the method already described it can be closed in two stages by another method

First stage.—Flaps A B C D and E F G H are outlined and freed care being taken to avoid injuring the great palatine arteries. The flap I J K L, attached at K L, is turned backwards and sutured to the



Figs. 322 and 323.—These and the six following diagrams illustrate the application of Arbuthnot Lane's method to different varieties of cleft (*see* text for each).

nasal septum along its line of contact, after the mucous membrane on both flap and septum has been removed along this line. The two large lateral flaps are then pivoted inwards and their anterior extremities are sutured together as in Fig 327

Second stage—This is deferred until the raw surface left after the first operation has completely healed. Flaps A B C D and A E F G (Fig 328) composed of mucous membrane and submucous tissue only are raised, displaced inwards, and sutured to each other along their inner margins. A row of sutures is also placed between the flap on each side and the subjacent edge of the cleft, indicated by the dotted line in Fig 329

Although a considerable area of raw surface is exposed after any

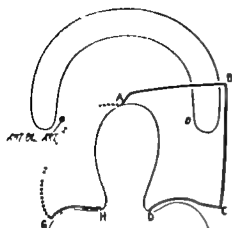


Fig 324.

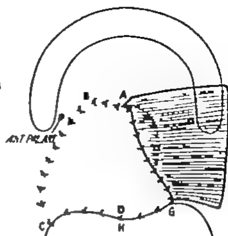


Fig 325.

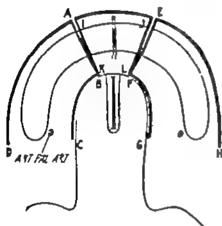


Fig 326.

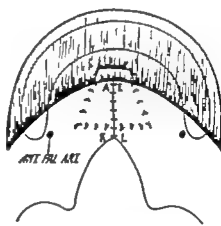


Fig 327

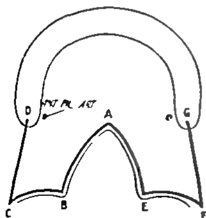


Fig 328.

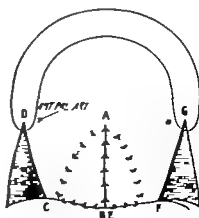


Fig 329

of the foregoing operations it is surprising how rapidly it becomes covered by mucous membrane and how slight is the scarring Sloughing of the flaps seldom occurs and union becomes quite firm in about five days.

The **late operation** should be performed at about the eighteenth month.

Advantages —

1 The cleft narrows as age advances.
2 The tissues are thicker and less friable than in the young infant.
3. There is less danger of postoperative pneumonia.
4. The co-operation of the child may be invoked during the healing process, so that it refrains from crying or talking, and from pressing its tongue against the palate.
5 If the operation is successful the appearance of the palate and the mobility of the soft palate are unsurpassable.

Disadvantages —

1 Coincidently with the appearance of the teeth, the bacteria and the putrefactive organisms that normally inhabit the mouth increase in number and variety
2 In consequence the danger of sloughing is very great.
3. The amount of tissue available for union depends upon the thickness of the flaps alone.
4 If there is the least tension the coaptation sutures commence to tear out very shortly after the operation.
5 Owing to these drawbacks the percentage of failures is greater than the percentage of successes.

The operation (Langenbeck's).—The uvula being seized with toothed forceps, both edges of the cleft are carefully and thoroughly pared. Two lateral incisions (Fig 330) are then made midway between the alveolus and the margins of the cleft they should commence near its anterior limit, and extend backwards as far as is necessary to relieve tension when the two halves of the soft palate are approximated. The mucous membrane of the hard palate, between the lateral incision and the edge of the cleft on each side, is then thoroughly separated with a curved elevator One blade of a pair of rectangular scissors is now introduced between the muco-periosteum and the bone, and pushed gently backwards until the posterior border of the hard palate is reached. The scissors are then rotated until the other blade lies in the naso-pharynx above the soft palate which is divided at its attachment to the hard palate (Fig 331). When this step is completed, should the two halves of the soft palate fail to meet, the lateral relieving incisions must be extended backwards. Sutures of silver wire fine salmon-gut, or silk are then inserted

from behind forwards and the suture line and raw lateral surfaces are given a coating of Whitehead's varnish

To relieve tension after the sutures have been tied some surgeons pack the lateral incisions with gauze in order to push the flaps inwards but, owing to the decomposition of the exudate absorbed by the gauze, this is not a satisfactory method. C. H Mayo ties the flaps together with a piece of tape which is then rotated so that the knot projects into the nasal cavity The writer transfixes the flaps with two or four strands of fine silver wire, and fastens the ends with perforated shot over an aluminium plate which is bent over their lateral edges (Fig 330) The advantages of this method are the relief of tension, the support given to the flaps by the wire, and the accurate apposition of their approximated edges

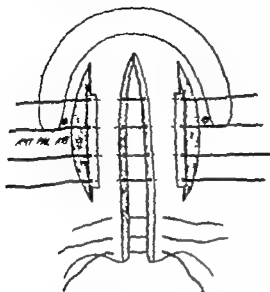


Fig. 330.—Langenbeck's operation (writer's modification) Flaps transfixed by silver wires held in position by aluminium plates.

Gillies's operation (p. 164) is best explained by the annexed diagrams (Fig 332)

After treatment.—The mouth should be sprayed daily with a mild antiseptic and alkaline lotion but no attempt should be made to inspect the wound lest the child struggle and cry Liquid nourishment in small quantities at a time should be given with a spoon for the first week, after which the amount may be increased A baby must be nursed and soothed to prevent it from crying, and an older child must be forbidden to talk. The splints are removed on the fifth and the stitches on the tenth day during the process it is always

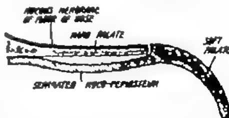


Fig 331 —Langenbeck's operation The soft palate and the mucoperiosteum of the hard palate have been completely separated from the bone.

advisable to make the child drowsy with an anaesthetic. No matter how perfect the cosmetic result, no operation for cleft palate can be called successful unless the speech be improved. Consequently it behoves the surgeon to urge the necessity of lessons in elocution by a competent teacher as soon as possible, for without such lessons many patients will be unintelligible and few will articulate clearly In some the result of careful training is so excellent that the ordinary observer would not suspect the presence of a congenital defect. It is always advisable to see the patient some three months after the operation if then the soft palate appears unduly tense, increased flexibility and a corresponding improvement in the speech will be obtained by teaching the mother or the nurse to massage and exert pressure upon it with the finger



Fig 332.—*Combined surgical and dental treatment of cleft palate* Gillies's operation.
A, Congenital cleft of hard and soft palate B, Approximation and lengthening of soft palate, which is completely separated from the hard palate. C, Apparatus for the application of skin graft to the raw anterior edge of palate. D, Apparatus by Mr. Fry for stretching soft palate after healing E, Final result hard palate fitted with dental appliance long, movable, soft palate which can approximate to pharyngeal wall and give good speech (*Diagrams by S Horsnell*)

SELECTED BIBLIOGRAPHY

Brophy *Proceedings of Third International Dental Congress*, Paris, 1900.

Gillies and Kelsey Fry "A New Principle in the Surgical Treatment of Congenital Cleft Palate and its Mechanical Counterpart" *Brit. Med. Journ.* 1921 i. 335.

Keith, A., "On Congenital Malformations of the Palate, Face, and Neck," *Brit. Med. Journ.*, 1909, ii. 312.

Lane, Arbuthnot, "The Modern Treatment of Cleft Palate," *Lancet*, Jan. 4, 1908

Owen, Edmund, *Cleft Palate and Hare-Lip*. London, 1904.

THE TONGUE

By W H CLAYTON-GREENE, B A , M B
B C. F R C.S

Development.—The tongue is developed from two separate elements in the floor of the primitive pharynx. The *buccal or anterior* portion arises during the third week (Keith) from the 1st branchial bar and interbranchial space by the development of the tuberculum impar (Fig 333) a median elevation. It was at one time held, as the name suggests, that there was a single unpaired

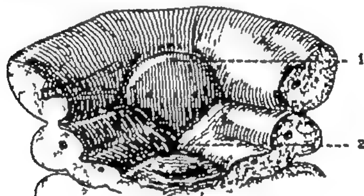


Fig 333 —Diagram showing development of the tongue

1, 1 tuberculum impar 2, posterior portion of tongue, developed from 2nd and 3rd arches.

element entering into the formation of this part, but it has been shown that right and left elevations arise and fuse to form the tubercle. This early evidence of bilateral origin more clearly explains the rare conditions of bifid tongue and median cysts sometimes found

This portion developed from the mandibular arch is innervated by the special nerve of this part, the 5th, while the chorda tympani, a sensory nerve to the 1st branchial cleft, also supplies it.

The *pharyngeal* portion is developed from the fused ends of the 2nd and 3rd arches (Fig 333) The glosso-pharyngeal—the nerve of the 3rd arch—supplies this part.

Between the anterior and posterior portions there is found at one period a well-marked V-shaped groove, which ultimately is occupied

by some of the circumvallate papillæ. Farther from the hypoblastic covering in the middle line a downgrowth of epithelium takes place which forms the median tubular portion of the thyroid gland, and which normally is responsible for the production of the small median depression at the apex of the V called the foramen cæcum (Fig. 334) Under normal conditions this duct or canal the thyro-glossal duct, should disappear but it may persist, and cysts may arise in any part of its course. Cysts and tumours, thyro-glossal in origin, are sometimes met with in the substance of the tongue.

The *muscles of the tongue arise in a curious way from* the three posterior head segments. They grow forward into the fundament

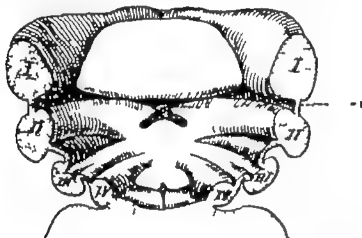


Fig 334.—*A more advanced stage of development of the tongue than that shown in Fig* 333.
Foramen cæcum.

of the tongue, carrying with them their appropriate nerve, the 12th cranial or hypoglossal.

General anatomy of the tongue.—The *body* of the tongue is composed of striated muscle, of which the genio-hyo-glossus and the hyo-glossus are the largest extrinsic muscles.

The *dorsum* is covered with a peculiar mucous membrane, and is divisible into two areas which correspond closely with the two portions developed respectively from the tuberculum impar—the lingual portion and that which arises from the 2nd and 3rd arches, the pharyngeal part—these two portions being separated by the V-shaped groove mentioned above, along which lie the circumvallate papillæ.

The anterior or lingual portion is covered with mucous membrane beset with filiform and fungiform papillæ, the former being delicate papillomatous processes of connective tissue covered with epithelium.

When this epithelium proliferates and desquamates in excess and especially when bacteria and food particles collect in the spaces between the papillæ the condition described as furred tongue arises. In the middle line a slight fissure may be seen, which in some pathological conditions becomes peculiarly exaggerated.

The posterior or pharyngeal portion is beset with small nodular masses, each surrounding a central pit visible to the naked eye. These nodules are masses of lymphoid tissue and in the aggregate are termed the lingual tonsil.

The circumvallate papillæ which are placed at the junction of the two parts are actively concerned in the sense of taste they are flat-topped elevations surrounded by a trench in which the taste-buds are embedded. The V-shaped groove along which these papillæ lie is termed the sulcus terminalis and at its apex the foramen cæcum may be occasionally found. At its extreme posterior part the dorsum linguæ is attached by a median fold to the epiglottis, the glosso-epiglottidean fold while laterally it is connected to the pharynx by the pharyngo-epiglottidean folds, which together with the glosso-epiglottidean folds form the boundaries of the two lateral depressions, the valleculæ.

The *inferior surface* is free from papillæ but shows a median band, the frænum linguæ connecting the mucous membrane of the tongue with that of the floor of the mouth and close to the latter on either side of the frænum the openings of Wharton's duct, the duct of the submaxillary gland, can be seen.

On either side of the frænum the large ranine veins are clearly visible, while placed still farther laterally are the plicæ fimbriatæ—folds which correspond to the under tongue of the lemurs, and which mark fairly accurately the course of the ranine arteries.

The *lateral margins* possess papillæ similar to those found on the anterior part of the dorsum, while just in front of the anterior palatine fold—a band which descends to the tongue in front of the tonsil and contains the fibres of the palato-glossus—a number of vertical ridges are situated, the folia linguæ, which are studded with taste-buds and represent the papillæ foliatæ of the rabbit.

The **muscular mass** of the tongue is divisible into two main groups, the extrinsic muscles, which reach the tongue from surrounding bones and structures, and the intrinsic or linguales which are confined to its substance. Except the palato-glossus, which probably derives its nerve supply from the spinal accessory by means of the pharyngeal plexus, the muscles are supplied by the hypoglossal nerve.

Glands of the tongue.—There are a number of small racemose glands situated in the posterior part of the tongue and a few are found in relation to the circumvallate papillæ.

The most important, however are the apical glands of Blandin and Nuhn which are situated on the inferior surface a little distance from the apex.

They are mixed serous and mucous glands, and they open by means of three or four small ducts on either side of the upper attachment of the frænum.

Arteries.—The main artery of the tongue is the lingual, a branch of the external carotid, which reaches the organ by passing under cover of the hyo-glossus muscle, its terminal branches being the sub-lingual to the sublingual gland, and the ranine, peculiar to the tongue. There is no free anastomosis between the vessels of the two sides. The posterior portion is supplied by the dorsalis linguæ branch of the lingual, reinforced by the tonsillar branch of the facial

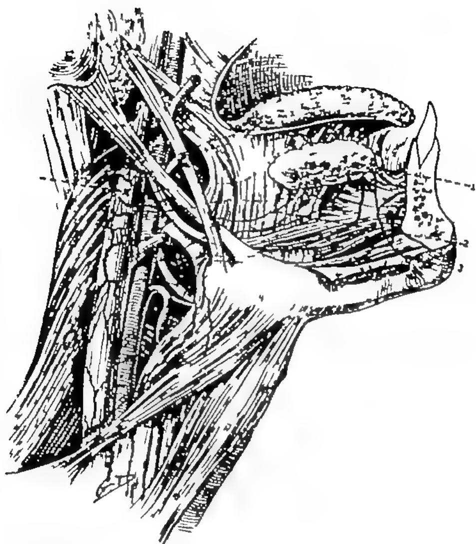
Veins.—The veins do not follow closely the course of the arteries. There are two venæ comites which run with the lingual artery beneath the hyo-glossus, but they are small the greater part of the blood being conveyed back by the ranine veins two large vessels situated one on either side of the frænum, immediately beneath the mucous membrane. These veins pass backwards over the hyo-glossus and usually join with the venæ comites to form a common trunk which receives the dorsalis linguæ vein before joining the internal jugular

Nerves.—The anterior two-thirds of the mucous membrane is supplied by the lingual branch of the inferior maxillary division of the 5th nerve accompanied by the chorda tympani, which may convey special taste-fibres to the former but more probably is concerned with supplying the lateral margin of the tongue. The posterior third is supplied by the glosso-pharyngeal which is generally considered to be the special nerve of taste. A few fibres are also derived from the superior pharyngeal branch of the vagus. The nerve supply of the muscles has been described.

Lymphatics (Plate 86).—In modern surgery the course of the lymphatic vessels influencing as it does the spread of malignant disease, is of the utmost importance.

In the tongue itself there are two main sets of lymph-channels, the rich submucous network, and the scantier intramuscular vessels in the case of the former it is to be noted that there is communication between the lymph vessels of the two sides across the middle line. From these vessels the lymph passes to the glands, the muscular lymphatics uniting early with the submucous and it is possible to define four distinct sets for the purposes of description, as follows —

1 The *apical set* pass from the submucous network on to the genio-hyo-glossus some of the vessels pierce the genio-hyoid and terminate in the submental glands and the inferior cervical glands



The lymphatic glands draining the tongue.

1 Submaxillary gland and its lymph nodes. 2, Gland on hyo-glossus. 3, Submental group. 4, Deep cervical chain.

PLATE 86.

This latter fact is of supreme importance since in malignant disease of the tip of the tongue both the submental and submaxillary regions may escape the infection being carried directly to the glands which lie along the internal jugular vein at the point where it is crossed by the omo-hyoid muscle

2. The *lateral set* descend from the sides of the tongue and terminate mainly in the submaxillary lymph glands these are situated not only in relation to the submaxillary salivary gland but are actually embedded in its substance—a condition which necessitates removal of the gland in malignant disease In operating for this condition it is also necessary to remember that at least one of the lymphatic glands of the submaxillary group lies actually on the face in front of the edge of the masseter muscle A few lymphatic channels pass directly to the superior deep cervical glands The lymph from the submaxillary region passes into these cervical glands one of which, situated at the level of the bifurcation of the carotid is especially important and is often described as the principal gland of the tongue

3. The *basal set* arise in the submucous tissue and lymphoid follicles of the posterior part and pass deeply to the superior deep cervical glands.

4. The *median set* arise from the submucous network in the middle line in front of the circumvallate papillæ The vessels pass deeply between the genio-hyo-glossi and finally after piercing this muscle and the hyo-glossus end in the submaxillary glands.

A point of special importance is to be noted in connexion with this median set namely that according to Piersol they may pass to either side of the middle line thus accounting for infection of the glands of the neck on the side opposite to that upon which a cancerous ulcer is found.

The lymphatics from the floor of the mouth have a termination similar to that of the lymphatics of the tongue

Occasional glands will be found embedded in the substance of the hyo-glossus.

Methods of examination of the tongue.—In examining the tongue for the many surgical diseases which attack it, both inspection and palpation are necessary In the case of the former a good light is essential and the patient should preferably be sitting opposite to the surgeon If daylight should not be available, or if swelling of the tongue should impair the view a laryngeal mirror will afford great assistance especially in cases of deep hæmorrhage or, better still, a small portable lamp which can be sterilized may be introduced directly into the mouth an old cystoscope acts admirably

A metal or glass tongue-depressor should be at hand and lip-retractors are required in a difficult case.

If the tongue be foul and covered with fur or adherent sloughs, these should be gently wiped away with cotton wool swabs steeped in weak carbolic acid (1 60) or the surface of the tongue can be dried by pressing a strip of white blotting-paper over it—a proceeding which brings out more clearly some of the pathological conditions met with.

Palpation is of special value in detecting the characteristic induration of malignant disease, the nodular hardness of a primary chancre, and the local tenderness of an abscess it is advisable to protect the finger with a glove or finger-stall.

Histological and bacteriological examination supplement the former procedures. These methods are specially required in the case of doubtful ulcers, of which a piece—not too small—should be removed and examined microscopically If too small a piece is removed the examination will be very unsatisfactory and an effort should be made to obtain some of the adjacent apparently healthy tissue since this will show in a more convincing manner the spread of any malignant epithelial cells.

Bacteriological investigation is required in some of the parasitic diseases, diphtheria and thrush, and abscess.

Stress must be laid on the following points —

1 It is difficult to obtain fluctuation in many cases of abscess.

2. The ulceration which occurs around a calculus impacted in Wharton's duct is easily mistaken for malignant ulceration.

3. Inflammatory conditions in the submaxillary gland may be confused with acute glossitis.

4. When an ulcer is acutely tender it should be painted with some 1 per-cent. cocaine solution before palpation is practised.

MALFORMATIONS

ABSENCE OF THE TONGUE

Several cases of so-called absence of the tongue have been recorded, but in each instance the case seems to have been one of suppressed development of the tuberculum impar rather than actual absence of the organ. In such cases the anterior portion of the organ is small and rudimentary and is moreover firmly fixed to the floor of the mouth, rendering free movement impossible. The base is always present and apparently normal. In a case seen by me the above condition was associated with arrested development of the lower jaw the whole bone being small and underhung As in other recorded cases of the deformity the speech was intelligible

BIFID TONGUE

This very rare condition arises from the incomplete fusion of the two parts which form the tuberculum impar and represents a developmental error occurring at a very early date, the form being comparable to the forked tongue of the reptiles The malformation may be associated with hare-lip or cleft palate.

Treatment is comparatively simple in those cases that require it. The edges of the cleft are pared and the raw surfaces united with sutures.

ANKYLOGLOSSIA

Abnormal fixation of the tongue occurs as either a congenital or an acquired deformity The congenital variety when not associated with a rudimentary condition of the organ results from intra uterine inflammatory changes or from imperfect destruction of embryonic structures such as the pharyngeal membrane, or possibly as the result of imperfect innervation and movement. The amount of control of the frænum upon the tongue being largely influenced by movement of the organ, as shown by the fact that some cases of acquired tongue-swallowing are due to stretching of this anchoring band it is possible that as in the case of joints, some interference with the normal range of movement that should obtain during embryonic life is responsible for the short and adherent frænum.

Cases such as the one described by Lapis, where there were large adhesions between the tongue and the palate—a form described by French writers as superior ankyloglossia—suggest either some inflammatory source for the adhesions, or the persistence of some membrane while in the more common variety—the inferior ankyloglossia which is the more complete when the tongue is very rudimentary—it would seem probable that lack of motive power is an important factor in producing this result.

In this inferior form we can recognise two varieties—the complete which is properly considered above under the heading of congenital absence, and the more common partial form. In point of fact, partial ankyloglossia is uncommon, as insisted on by Butlin, who deprecates the number of unnecessary operations often performed for a condition which will tend to rectify itself The routine section of the frænum is to be unhesitatingly condemned. Children of rather weak mental development, who learn to speak late, are often subjected to the operation of · cutting the tongue-tie, in the hope that it will help the development of speech This idea is entirely erroneous, since given the requisite mental power speech is quite possible in the most severe forms of ankyloglossia.

Should, however a case present itself in which the frænum is

obviously too short, and especially if the child's feeding is interfered with, the operation becomes necessary

Treatment.—The frænal band is rendered tense, and is nicked with a pair of scissors close to the jaw so as to avoid injuring the ranine vessels. The wound must not be enlarged by tearing up the tongue with the finger If the child is put to the breast or given a teat to suck, the movement of the tongue thus induced will help to prevent recurrence.

This operation is by no means free from danger A case of fatal hæmorrhage is quoted by Reboul, while macroglossia developed in cases recorded by Burton, Sedillot, and Dollinger If the tongue is carelessly stripped up after the band has been divided, an ugly wound is left which may form a troublesome ulcer or cause so much cicatrization that the tongue becomes more fixed than it was at first. For serious hæmorrhage following division of the frænum, a strip of gauze dusted with iodoform should be gently packed into the sublingual region on to the bleeding area, and the tongue then pulled out by a suture passed through its tip and strapped to the chin thus the bleeding area is fairly firmly compressed If this method fails to arrest the bleeding, an anæsthetic must be given and the vessel under run with a curved needle threaded with catgut. The cautery must not be used.

Acquired Ankyloglossia

This condition is the result of extensive destruction of the organ following sloughing in smallpox, or mercurial or caustic poisoning occasionally it is due to widespread syphilitic damage, or to operative procedures of various kinds.

TONGUE-SWALLOWING

Excessive mobility of the tongue usually results from extreme length and looseness of the frænum which therefore fails to control the movements of the organ the tongue itself is unduly long Fairbairn records a case of suffocation, and Hennig mentions a case where the child died in a paroxysm of whooping-cough, apparently from sucking the tongue into the pharynx.

A similar but less marked condition sometimes occurs in patients under the influence of anæsthetics, and after removal of portions of the tongue it is one of the complications to be specially treated

If the child be seen in a state of suffocation arising from this cause the finger should be introduced into the mouth, and the tongue hooked forward. The condition is likely to recur but the constant sucking of a teat will help to prevent it.

INJURIES

WOUNDS

Injuries to the tongue, rarely the cause of serious hæmorrhage, usually penetrating wounds produced by foreign bodies such as pipe-stems and fish-bones, but are specially important in that an abscess of the tongue may follow and the foreign body may be retained in the tongue substance. Many instances are recorded where pipe-stems or teeth have been removed from the tongue some time after an accident, comparatively few symptoms having arisen during the interval.

Occasionally severe or even fatal hæmorrhage may occur as in the case published by Bransby Cooper where the pipe-stem penetrated through the tongue into the carotid artery and the patient, a sailor, died from bleeding.

The tongue may be severely bitten in the convulsions of epilepsy, eclampsia or tetanus, or as the result of blows or falls on the chin, and the bleeding may be serious. In ordinary circumstances the tongue is rarely severely bitten during mastication, but if the hypoglossal nerve is paralysed considerable damage may be done.

Treatment.—The chief indications in treatment are—first, to control any hæmorrhage and second, to make certain that no foreign body is left behind in the muscular substance.

When the tongue is bitten it is usually the anterior part that suffers, a part easily accessible and amenable to simple treatment.

On the other hand, in punctured wounds the lesion may be far back and if, as Butlin points out there be free arterial hæmorrhage, owing to the fact that the vessels lie deeply there will be a deep wound in which a foreign body may be hidden, and in which it may be very difficult indeed to secure the bleeding point.

For the temporary arrest of severe hæmorrhage the manœuvre recommended by Heath should be adopted. The forefinger is passed to the back of the tongue, and the whole organ is hooked forward with the hyoid bone, the lingual arteries being thus put on the stretch.

In the slighter forms, where the hæmorrhage is mainly venous, it will be sufficient to approximate the edges of the wound with catgut or black silk the stitches should not be tied too tightly as the tissues swell up considerably but they must arrest the bleeding.

In severe hæmorrhage an anæsthetic must be given the mouth should be widely opened, the tongue drawn out by two stitches passed through it near the tip, the wound enlarged if necessary and a search made for the bleeding-point. This is a difficult matter even when skilled assistance is at hand, and without it the operator is severely handicapped

It may be wise, owing to the severity of the hæmorrhage, to perform laryngotomy and to plug the pharynx before attempting to deal with the bleeding I strongly recommend this in a difficult case, as I have invariably practised it before any extensive operation on the mouth or jaws, and am very much impressed with its value.

A good deal of difficulty will be experienced, even under the best conditions, in applying a ligature to the bleeding vessel, as the tongue tissue is friable and readily tears away in the pressure-forceps. If this occurs, it is better at once to under-run the vessel with a silk ligature by means of a curved needle even though some of the lingual tissue is included and may slough, the procedure is a satisfactory one. The hæmorrhage having been arrested, search must be made for a foreign body and the edges of the wound may be drawn together, but it must not be closed completely

Cases may be met with where the above directions will fail, necessitating ligature of the lingual artery or even of the external carotid in the neck, but they will be extremely rare.

In secondary hæmorrhage the same treatment should be carried out, though the sloughing condition of the tissues may make ligation of the vessel a matter of the greatest difficulty and the operator will do well to under-run it with a silk ligature at once. It will rarely be necessary to tie the main vessels in the neck.

The **after-treatment** of wounds of the tongue consists in promoting oral asepsis with mouth-washes, of which carbolic acid 1 40 hydrogen peroxide 1 4, are the most effective. Fluids only must be taken, and if there is much swelling and pain the patient should be fed per rectum. A careful watch must be kept for œdema of the glottis, a complication necessitating tracheotomy also for secondary hæmorrhage and for abscess.

Gunshot wounds are to be treated on the same main lines as punctured wounds they are very liable to be followed by secondary hæmorrhage and abscess, and therefore should not be closed completely

Stings of the tongue are to be regarded as poisoned wounds. Generally speaking, the treatment should be similar to that employed for scalds, but there is some danger of onset of œdema of the glottis.

BURNS AND SCALDS

The degree of severity of these injuries varies, here as in other parts of the body from slight erosion to deep destruction.

Slight burns which result from cigarettes or other causes merely lead to superficial destruction of the papillæ, but are very painful from the exposure of the sensory nerve-filaments. Sometimes a slight burn is the starting-point of an ulcer, and in some cases the condition has progressed from one of trivial injury to epithelioma. For this

reason Butlin warns against the use of the cautery in simple diseases of the tongue

In the corrosions produced by strong mineral acids and caustic alkalis the back of the tongue suffers more than the anterior part indeed it is not uncommon for the tongue to escape the œsophagus and stomach receiving the chief damage. When affected, the mucous covering of the tongue is destroyed and peels off as a superficial slough and the whole organ swells as in parenchymatous glossitis. Corrosive sublimate produces a characteristic white shrivelled appearance.

Severe scalds are most usually met with in children who have attempted to drink out of a boiling kettle the steam rather than the water producing the injury The effects are often very severe, the tongue becoming enormously swollen and covered with blebs in fact a state of acute glossitis is set up

In all the above conditions, so long as the trouble remains limited to the tongue there is little need for anxiety but unfortunately especially in scalds, owing to the coexistent damage to the epiglottic region and the upper respiratory tract, œdema glottidis and pneumonia may follow

General treatment.—According to the severity of the burn or scald, solid food must be prohibited, and the patient should be fed on fluids, even rectally in the more serious injuries. Ice may be sucked, and in adults the painful areas may be painted with a 1 per cent. solution of cocaine. Chlorate-of potash mouth-washes are of value from the first later when the pain is less, astringent lotions should be substituted.

The blebs which form rarely require treatment.

A careful watch must be kept for signs of œdema of the glottis as shown by stridor and dyspnœa. In adults scarification may be of value occasionally but in children it is wiser to perform tracheotomy than to try what is always a difficult operation even in adults.

INFLAMMATORY DISEASES—ACUTE

Acute inflammatory lingual diseases are here dealt with according to the following scheme —

1 Superficial. { Local. / Diffuse { Nervous. / Membranous.
2 Deep.
3 Unilateral.
4 Inflammation of the lingual tonsil.
5 Abscess.
6 Gangrene.

1 ACUTE SUPERFICIAL GLOSSITIS

Is seen to follow most burns or injuries of the tongue of slight extent and tends in these cases to be local or patchy readily yielding to mild remedies such as mouth-washes or emollient applications of borax, borax and honey or listerine.

The diffuse form occurs in two main types, the nervous and the membranous.

The **nervous** variety which is often unilateral takes the herpetic form which is described on p 193.

Membranous glossitis may occur as part of a generalized diphtheria, the disease then not being confined to the tongue. The tongue and the submaxillary lymphatic glands are swollen. Wharton published a case of primary diphtheria of the tongue—a very rare condition. True diphtheria can only be diagnosed if the typical Klebs-Löffler bacillus be found.

Membranous glossitis not due to *B diphtheriæ* may sometimes be seen, for example, in children who are suffering from measles and who are the subjects of impetigo and eczema. The membrane contains desquamated epithelium and streptococci or staphylococci.

Hutchinson described under the name *pellicular glossitis* a more chronic form which occurs in smokers.

Treatment of acute superficial glossitis is simple. A purge is given and the patient is put upon a liberal though fluid diet. Ice may be sucked if there is much pain, and 10–15 grains of chlorate of potash should be administered to an adult until a drachm has been taken. This drug, given internally is of very great value in the inflammatory or ulcerated conditions of the tongue and mouth but must be given with caution especially in children, as it is liable to produce hæmaturia Weak solutions of cocaine may be applied occasionally for pain, or a mouth-wash of listerine used as an alternative. When the acute stage subsides astringent lotions—alum, 10 gr to the ounce, or zinc sulphate 2 gr to the ounce—should be substituted. Occasionally a solution of bicarbonate of soda 30 gr to the drachm, will be found more serviceable than the other lotions

In the membranous forms the tongue should be swabbed with 1 1 000 perchloride of mercury and, if the Klebs-Löffler bacillus is isolated, antitoxin should be given.

2. DEEP OR PARENCHYMATOUS GLOSSITIS

This is a comparatively rare condition and affects adults, males rather than females. The disease comes on with pain and stiffness in the tongue the pain often being referred to the neck and ear' the

tongue swells progressively until in extreme cases it cannot be retained in the mouth but is protruded indented and cut by the teeth which have pressed into it. The swelling is hard and tender The dorsum of the tongue is covered with a thick white fur and there is profuse salivation the glands in the neck are swollen and tender and the temperature and general condition are indicative of an acute septic intoxication.

Etiology—*This affection is said to be more common in cold and damp weather* Over indulgence in alcohol appears to have a predisposing influence but the most important factor is undoubtedly a septic state of the mouth and teeth Of the many organisms which normally inhabit the mouth the staphylococci and the streptococci seem to be the most important agents in exciting the condition

The staphylococcal form is the less acute, and tends to be more localized. The streptococcal variety on the other hand, is associated with extreme swelling of the tongue which may pass back to the aryteno-epiglottidean folds, and of the glands in the neck. Sabrazès and Bousquet quote a fatal case secondary to puerperal fever and Syme records two cases that occurred in workmen engaged in cleaning out a sewer Mercurial glossitis will be considered later

Course.—The disease runs on to resolution in the milder forms but some permanent thickening and stiffness may be left for months after the acute process has subsided. In other cases, suppuration follows, a deep abscess being formed which is not easily detected. Occasionally sloughing and even gangrene may occur and the tongue may be extensively destroyed and become fixed to the floor of the mouth.

The risk of œdema of the glottis and of septic pneumonia is very great in the streptococcal variety

After the acute stage has subsided some permanent thickening of the tongue substance may be left—one variety of the "*glossites profondes chroniques*" of the French, a condition easily mistaken for one of the manifestations of syphilis.

Treatment must be active from the start. It should begin with a calomel purge hot mouth washes of 1 60 carbolic acid should be prescribed and leeches applied to the submaxillary region If the swelling be great as in the streptococcal type free incisions should be made into the dorsum of the tongue, two-thirds of an inch on either side of the middle line and one-third of an inch deep (Butlin) they should be made freely with a curved bistoury The relief is almost immediate and severe bleeding is rare.

Modern treatment naturally suggests the use of vaccines especially in the staphylococcal and streptococcal infections.

In some instances the pain complained of is of a severe burning character in appearance the tongue seems raw though in actual fact the "raw areas are covered by a thin layer of epithelium. These areas are very liable to suffer from slight traumatism which would not affect the normal organ, and the patient has recurring attacks of acute soreness and excoriation.

Pathologically the tongue appears to be the seat of a chronic superficial inflammation, though here the response is peculiar when compared with the other varieties of this affection, in that its sensitiveness is increased and the epithelium has no tendency to proliferate.

Gouty subjects are especially liable to this condition.

Treatment.—Suitable measures must be taken to deal with the dyspepsia, or gout if it be present and the teeth must be carefully attended to since collections of tartar sharp edges, or carious stumps will, if allowed to remain, render any treatment abortive.

Mouth washes of chlorate of potash or other non irritating antiseptics should be employed, and the tongue should be painted occasionally with chromic acid, 10 gr to the ounce. If there is much pain a half per-cent. solution of cocaine may be applied, or a cocaine ointment may be ordered. Carbolic acid (1 80) will sometimes succeed when the other drugs fail.

3 FURROWS

The tongue is sometimes found cut up by a number of deep grooves or furrows. Some, but not all of these are the result of chronic inflammatory changes, either simple or specific the grooves resulting from the scarring in the submucosa the syphilitic varieties will be considered later In other cases, as for example, the "fern-leaf pattern" tongue, the inflammatory origin is not so clear, and we are forced to the conclusion that such a condition is only one of the natural varieties of configuration in which the depth of the natural grooves or sulci is exaggerated. The natural grooves are usually longitudinal, the acquired transverse.

When however fissures or cracks result from chronic inflammation, they are apt to be a source of anxiety to the patient from the pain they cause, and to the surgeon from their tendency if remaining unhealed for a long time to become the seat of cancer

Treatment.—The mouth must be kept clean with ordinary mouth-washes, and chromic acid applied to the bottom of the fissure by means of a small camel's-hair brush. Ointments are very useful

4. GLOSSODYNIA EXFOLIATIVA

In this condition violent pain is complained of in the tongue out of all proportion to the local change, which is very similar to that

occurring in the preceding variety It appears to be a neuralgia of the lingual nerves associated with a thinning of the epithelium which may be compared with the trophic changes occurring in some forms of trigeminal neuralgia Anæmic women are more subject to it than men

Treatment.—The application of nitrate of silver or the actual cautery is sometimes of service. Da Costa mentions a case in which the chewing of a piece of tarred rope relieved the pain.

5 HERPES

Attacks the tongue as it does other parts of the body the resulting eruptions having all the usual features of the herpetic type There is a formation in the epidermis of multiple vesicles which are surrounded by inflammatory zones. In some cases the vesicular formation proceeds to such an extent that the term *hydroa* has been given to it. The ordinary course of the disease is for the vesicle to rupture sometimes becoming pustular first and to leave an ulcer covered with a pellicle which consists chiefly of desquamated epithelium.

Healing usually takes place under appropriate treatment, but occasionally the ulcer persists or even spreads. (See Herpetic Ulcers p. 199)

The amount of pain attending the eruption varies enormously in some cases it is violent comparable to the pain in herpes zoster

The disease is presumably of nervous origin with a remarkable tendency to recurrence this recurrence being favoured in susceptible subjects by excess in the use of tobacco or alcohol, or by exposure to cold. There is no evidence to connect the disease with syphilis, although it is often associated with herpetic eruptions on the penis. Dyspeptic subjects are said to suffer from it It must not be confused with the pustules of impetigo.

Treatment.—A sharp mercurial purge should be given, and careful dieting and complete abstinence from stimulants must be enjoined. Arsenic antipyrin, or phenacetin may be tried According to Butlin there are two classes of case—one in which a mouth wash of carbolic acid, spirits of chloroform, myrrh, and eau-de-Cologne will bring about speedy resolution another in which an ointment with a basis of lanolin and vaselin to which are added cocaine and a weak antiseptic such as boric acid will give the best result

6 LEUCOPLAKIA

Syn.—Leucokeratosis Ichthyosis Psoriasis Linguæ Smoker's Patch.

We now come to the most common form of chronic superficial glossitis—a form which as the above names imply presents itself in a number of different guises.

Pathology—As the result of some irritation—and it by no means follows that the irritant is of the same intensity and nature in every case—a chronic inflammation ensues in the mucous membrane of the tongue the papillæ disappear a corneous change takes place in the epidermis, and there is a development of scar tissue in the derma. Changes occur chiefly in the Malpighian layer where the cells become vacuolated and multiplied and loaded with eleidin granules.

It is most important to recognize that the features of a chronic inflammation are present in the true derma—a phase which is rightly regarded as indicating a want of stability a precancerous stage, in fact, together with abnormal and misdirected activity on the part of the epithelial cells of the epidermis. For a time at least matters are more or less equally balanced, and the barrier of dermal tissue keeps the epithelial cells in check, but weakened by the effects of inflammation and subjected to greater strain by the active changes in the epithelium, the barrier gives way the epithelial cells, sometimes preceded by a round-celled infiltration, pass beyond their normal limits into the subjacent derma, and a nucleus of cancer is formed.

Etiology—Smoking, syphilis, dental infection, and gout are the conditions mainly accused as being contributory if not actual causative agents, but, while they may be all or severally responsible for the production of chronic superficial glossitis, it is now generally acknowledged that the disease depends upon some inherent susceptibility or weakness of the superficial tissues of the tongue. Just as some patients are liable to skin eruptions and desquamations, so others are subject to superficial glossal changes, without any of the causes mentioned above contributing to them in the least degree.

Although syphilis produces a chronic inflammatory change in the superficial layers of the tongue, and in this respect paves the way for the development of a leucoplakial state, it cannot be too firmly insisted on that leucoplakia *per se* is not a syphilitic manifestation.

Smoking especially if a short hot pipe is used, undoubtedly produces localised areas of inflammation which are known as smoker's patches, and which are classed clinically under the head of leucoplakia. This must be allowed as an important but not the sole cause of the condition.

Almost any persistent cause of lingual irritation, such as long-continued drinking of crude spirits, or the presence of chronically infected teeth or teeth-sockets, may act as potent etiological agents. Most frequently several causes are at work simultaneously

Hartzell has reported a case in a girl of only 11 but leucoplakia is very rare before the age of 26–30

Clinical appearance.—The appearance of the organ varies with the stage of the disease and with the response of the tissues.

One of the earliest phases which can be well studied in a smoker's patch, is the development of a smooth red slightly raised area on the dorsum of the tongue. In cases where the epithelium has not proliferated to any extent or where it has been shed, this stage may persist for some time and involve smaller or larger areas of the dorsum linguæ; to this condition in which the papillæ have been removed the term "red glazed tongue" has been applied. In others, and perhaps the majority, the patch slowly becomes covered with a layer of thickened epithelium which gives it the appearance of having been covered with white paint that has "hardened, dried and cracked" (Butlin).

The patches may be multiple or the whole surface may be uniformly affected; the process tends to spread on to the buccal mucous membrane, or it may begin there and spread to the tongue. The thickened epithelium may form a definite plate of a warty nature. Cracks and fissures are apt to appear and a spreading ulceration which soon becomes malignant is often associated with it.

Symptoms.—There is little pain, hence many patients do not ask for advice until an advanced stage is reached. Occasionally "hardness and dryness" of the tongue is complained of; while if fissures and cracks are present, highly seasoned food or hot dishes may cause a sharp smarting, or even severe pain. Taste is not impaired.

Course.—The disease is extremely chronic, and when well advanced a cure is very doubtful. There are recurrent attacks of inflammation, and slowly but surely in a large number of cases the inflammatory stages pass into malignant ulceration.

Drugs have little effect in advanced cases, and antisyphilitic remedies far from being of benefit are often actually injurious. When there is a well-marked history of syphilis, or if other stigmata of the disease be present, mercury and iodide may be tried, but they should not be given indiscriminately. Very striking results are obtained by the use of salvarsan.

The prognosis is always unfavourable.

Treatment is mainly directed to removing any source of irritation, such as carious teeth or ill-fitting tooth-plates. Smoking must be prohibited. Tobacco-chewing is especially to be condemned. Spirits, strong wines, highly spiced or hot foods, should not be taken.

Mouth-washes of chlorate of potash, and paints of chromic acid 1–2 gr. to the ounce, salicylic or lactic acid, will be successful only in the early cases. When the tongue is harsh and dry it should be wiped with a clean, soft cloth, and a little ointment (see p. 193) rubbed in night and morning. No caustics should be employed.

there is no doubt that their repeated application has led to increase of the inflammation and has precipitated the development of cancer

Operation (Fig 335)—Any local thickened plaque or wart should be excised at once since it is probable that a cancerous

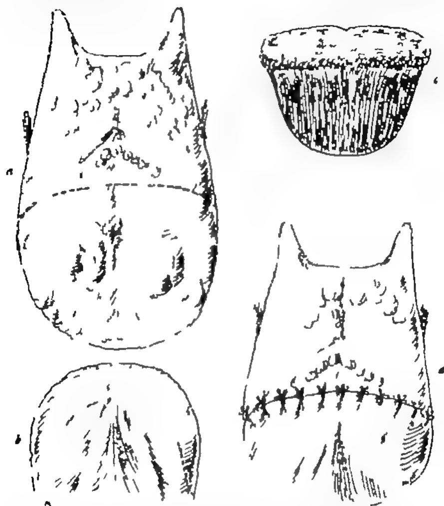


Fig 335.—Partial removal of tongue for chronic ulceration and fissuring

An incision across the dorsum and the under-surface of the tongue is made as shown in and *b*, and ventral flap turned back as in which shows the end of the stump. This flap is brought over the muscular stump and sutured to the cut mucous membrane on the dorsum, *d*.

(*After Butlin Burghard" System of Operative Surgery.*")

change has already begun Butlin was averse to interference unless definite warty conditions were present, but Morestin has published some cases of excision of large leucoplakial areas with a fair amount of success. He excised the affected areas with scissors,

and united the edges with sutures. In any case a very careful watch should be kept, and if there is the slightest suspicion that cancer has supervened, half or the whole of the organ should be excised.

Radium is not beneficial, as a rule in cases of leucoplakia There may be a temporary improvement but the disease returns worse than before

7 BLACK OR HAIRY TONGUE (NIGRITIES)

Is a rare condition due to the overgrowth of the filiform papillæ The affected area is usually found on the dorsum just in front of the circumvallate papillæ. No hairs are present but the long hypertrophied papillæ give the appearance of wet hair The colour is apparently due to bacterial action or to stains from smoke or particles of food. The disease causes no symptoms and is frequently discovered accidentally A mouth-wash and a salicylic paint should be ordered Mechanical cleansing by gentle scraping with a curved piece of whale bone or similar instrument is often useful.

ULCERS

Under this heading we consider the various morbid conditions which lead to ulceration of the tongue and some of the distinguishing features which characterise the individual type Butlin's valuable classification of the different varieties has been followed, but it is well to make clear at the outset that a state of ulceration is merely a further stage of the changes considered in the preceding section

SIMPLE ULCERS

Ulcers of this type usually result from longstanding, neglected chronic superficial glossitis. As has been pointed out previously there is a gradual transformation of the vascular submucosa into scar tissue with the inevitable result that the vitality of the part is impaired owing to its imperfect nutrition The relative avascularity of the fibrosed tissue interferes with the integrity of the surface epithelium, and further has an injurious effect upon the healing of any area that has been damaged and, as might be expected although in many cases a certain amount of improvement may be encouraged by appropriate treatment there is always an unfortunate tendency for the recently healed ulcer to break down again and again

Such ulcers are generally situated in the centre of the tongue and are fissured or stellate in shape with callous edges. Sometimes by a process of actual sloughing they extend laterally and deepen. The amount of pain they produce varies greatly and no doubt depends

upon the depth of the ulcer and also the state of the sensory nerve filaments of the papillæ. Any irritant food sets up a burning pain which lasts for some time, especially if the fissure is a deep one and particles of food become lodged in its depth.

The general lines of **treatment** are the same as for leucoplakia (see above) but in addition the floor of the ulcer must be carefully cleansed and local treatment in the shape of chromic-acid paint, 5–10 gr to the ounce, undertaken regularly night and morning. This application is certainly one of the best, for in addition to its great healing properties, it allays the pain and irritability of the ulcer The local treatment must be undertaken with great patience and discrimination if a good result is to accrue—and it is safe to say that no two cases react alike to the applications.

In some patients a weak carbolic lotion, 1 80 will succeed when the chromic acid fails in others more good will follow the use of a little iodoform powder tannic acid, or chlorate of potash. Dilute glycerine of tannic acid is of great service in many of the ulcerated conditions of the tongue. Nitrate of silver should never be used.

Again, it must be borne in mind that even when these ulcers and fissures occur in syphilitic subjects, the mere exhibition of mercury and iodides is insufficient to effect a cure nay more, by their powerful action on the oral mucous membrane they may make things worse—a point to be kept carefully in mind in treating syphilitic ulcers in the mouth. In such cases the local treatment should be as advised above Chromic acid is of great value in many of the specific lesions of the mouth.

In cases where the ulcer resists all treatment or relapses frequently especially if the edges become indurated, it should be excised by means of elliptical incisions, and the edges of the wound should be brought together by silk sutures after ligation with catgut of any vessels that require it. The stitches should be removed in four days.

DYSPEPTIC ULCERS

Arise in severe or exaggerated forms of dyspeptic glossitis in which the surface excoriations break down into true ulcers. They are usually situated near the tip and appear as small, circular punched-out multiple ulcers, with a red areola, associated with a general redness or beefiness of the anterior part of the tongue, the posterior part being covered with a thick, unhealthy fur Some patients seem possessed of an idiosyncrasy in regard to certain articles of food which have a regular tendency to produce such ulceration.

The general **treatment** is the same as for dyspeptic tongue but here local treatment with nitrate of silver is very beneficial.

HERPETIC ULCERS

While herpetic glossitis is chiefly the property of the adult, herpetic ulcers, in which the herpetic vesicles pustulate and ulcerate, are more commonly met with in unhealthy children between the ages of 6 months and 3 years. The child is thin and often ill nourished the bowels act sluggishly the mouth is hot and full of saliva and the breath offensive The teeth are often covered with tartar or are decayed. The ulcers, which are multiple, are covered with the membranous pellicle described above they affect the anterior portion of the tongue also its under-surface and the adjacent buccal mucous membrane.

The glands in the submaxillary region may be swollen

Treatment.—Give a dose of salts, castor oil, or rhubarb, and keep the bowels acting regularly Put the patient on a plain diet, including fruit but avoiding pastry Chlorate of potash in 4–5 gr doses may be given every four hours for two days, but it must be used with care as it often has an irritant action on the kidneys. The tongue should be kept clean with a piece of soft Turkey sponge soaked in boric-acid solution or a solution of bicarbonate of soda later more stimulating lotions such as alum or chromic acid may be needed

Mercury in all forms must be avoided. It may produce a gangrenous stomatitis in these subjects.

TRAUMATIC ULCERS

"Dental ulcers" are wounds that remain unhealed owing to persistent irritation. They result from rough, broken or irregular teeth, which are often carious, or from ill-fitting tooth-plates. Sometimes a broken pipe-stem may be responsible.

They vary enormously in depth and appearance, but are usually situated on the sides or the tip In more recent cases there is a shallow erosion—sometimes, however acutely inflamed—surrounded by œdematous tissue, and associated with glandular enlargement. Such a syndrome points to an acute bacterial infection superadded to the trauma. In most cases, however the ulcer is chronic, perhaps covered with a slough the edges becoming progressively indurated the longer the ulcer is left untreated.

Patients who suffer from such ulcers are usually in bad health. The tongue is covered with fur the breath is foul, and there is often a pronounced condition of pyorrhœa alveolaris.

The **diagnosis** may be very difficult in old and neglected cases, and the observer must always keep in mind the possibility of an ulcer with this appearance being tuberculous, syphilitic, or cancerous. The general points which influence the differential diagnosis will be

considered under the appropriate headings to avoid repetition but we must here draw attention to the tendency of such ulcers, if neglected to become ultimately carcinomatous.

In making a differential diagnosis the finding of some local cause is exceedingly important only recently I saw a patient who had a chronic ulcer which had been diagnosed as malignant. On inquiry it was found that the patient wore an ill fitting tooth-plate which pressed against the ulcer but as it was not always worn its importance in producing the condition had been overlooked; when this was remedied the ulcer speedily healed under the application of chromic acid

Treatment consists primarily in removing the source of irritation, and in applying local remedies such as chromic acid and ordering an antiseptic mouth-wash. In most cases the response to treatment is prompt. There is one point however which requires special attention While these ulcers are truly traumatic in their incipient stages, they become "infected" ulcers, as shown by their liability to undergo acute inflammatory changes, and by the glandular enlargement which accompanies them. As has been pointed out, a condition of pyorrhœa is often associated with them, which, by constantly reinfecting the ulcer renders local treatment futile. Such cases are eminently suitable for vaccine treatment, which in pyorrhœa has succeeded admirably in the hands of Goadby if this be undertaken together with the remedies advised above, healing of the ulcer will be speedy and complete.

In cases where treatment is resisted or where the surgeon suspects a commencing malignant change the ulcer with a margin of apparently healthy tissue, should be excised and submitted to microscopic examination. If a malignant change has supervened, the radical operation for lingual carcinoma should be performed.

ULCER OF THE FRÆNUM

This condition occurs in children affected with whooping-cough and is due to the tongue being forced up against the incisor teeth in the violent expiratory efforts of the coughing It has been incorrectly stated that this ulceration is the cause and not the effect of whooping-cough Sometimes these ulcers are associated with small papillomatous growths on either side of the frænum—Riga's disease. The ulceration subsides as the cough disappears.

MERCURIAL ULCERS

In ulcers resulting from the injudicious administration of mercury an unclean state of the mouth is a very important contributory factor Patients whose mouths are kept scrupulously clean are able to tolerate

mercury better and are much less liable to stomatitis and ulceration than those whose mouths are septic and unhealthy

The ulcers are multiple shallow and irregular in outline surrounded by a red area, but not so defined as the dyspeptic variety they may lead to extensive sloughing The tongue as a whole is swollen showing indentations from the teeth at its sides, the breath is foul, there is profuse salivation, the gums are swollen, spongy and retracted from the teeth, which are loose in their sockets. Such a picture is seldom difficult of diagnosis.

Treatment.—Give a saline purge and prescribe chlorate of potash 10 gr every four hours for two days (see above) Order astringent mouth-washes, sulphate of iron, or acetic alum (E. Lane) Nitrate of silver is of value, and for the salivation belladonna may be prescribed.

Tuberculous, syphilitic, and malignant ulcers will be considered specially in the sections on Tuberculosis (pp. 202–204) Syphilitic Diseases (p. 207) and Malignant Tumours (p 221)

TUBERCULOSIS

The present advanced state of our knowledge of the manifestations of tuberculous disease attacking the tongue is largely due to Butlin's writings, and his descriptions and opinions are closely followed in the ensuing section. In the past many of these cases were mistaken for malignant disease, and no doubt in a few instances they were successfully subjected to operative treatment and a permanent cure of cancer was claimed.

The systematic examination of all ulcers and tumours removed has shown us that the tongue like other tissues of the body is subject to tuberculous invasion, and in the diagnosis of difficult cases it has given us valuable information and occasionally unpleasant surprises.

Tuberculosis attacks the tongue either as a primary infection of the subepithelial tissues the bacilli reaching the part from the blood stream or by means of infected food or as a secondary complication of tuberculous disease of the lung or alimentary canal the tongue then being infected by the sputum When we think of the rarity of tuberculous disease in this region as compared with its frequency elsewhere and the constant exposure of the lingual surface to infected sputum in tuberculous subjects, we are forced to the conclusion that the tongue possesses special powers of resistance probably unless there is some breach in the surface epithelium, secondary infection of the organ does not occur

The diagnosis of the tuberculous nature of a lingual ulcer is facilitated by the discovery of signs of pulmonary disease

All authorities do not accept the occurrence of primary tuberculosis, and it has been held with some reason, that in the reported cases a localized patch of pulmonary tubercle has been overlooked.

Pathology.—The microscopic appearances of lingual tubercle are peculiar It is rare to find the system of tubercles at all well marked, while even the giant cells are scarce. Again, careful staining will often fail to reveal tubercle bacilli

In many cases the arrangement of the proliferating endothelial cells is atypical and in the form which is described as "infiltrating tubercle they may be mistaken for epithelial cells, and a diagnosis of new growth (endothelioma) may be made. In doubtful cases it may be necessary to inoculate a guinea pig with the suspected material.

The various tubercular lesions may be grouped under the following headings —

1 *Nodes* —Small nodular masses varying in size from a pin s head to a nut, multiple in cases of generalized miliary tubercle, or single in the locally infected cases. These nodules consist of tuberculous granulations, covered at first with normal epithelium, which with the increase in the size of the tubercle is liable to break down and leave an ulcerated surface.

The centre of the tuberculoma may undergo caseation.

2 *Fissures* which are really fissured ulcers, probably originally simple ones that have become infected with tubercle, are very difficult to diagnose When the edges of the cleft are separated, it is found to be much deeper than was expected and to be lined with swollen granulations, with perhaps caseating margins. The material scraped from the surface may be shown to contain tubercle bacilli. Occasionally the margins of these fissures are covered with protruding growths of a papillary nature, to which the name *tuberculous papilloma* has been applied.

3 *Ulcers* —The appearance of true tuberculous ulcers is very varied, no doubt because in but a very few instances, and then for a short time only is the infection unmixed. Sooner or later a tuberculous ulcer in a cavity such as the mouth is liable to contamination with the various bacteria and mycelia regularly found there, and thus becomes modified in appearance. This fact explains why some ulcers are covered with a foul slough, and others are surrounded by an indurated zone strongly suggesting cancer

It is a feature of the *pure* tuberculous process here, as elsewhere that there is complete absence of induration.

4 The *lupoid ulcer* which has been described by Butlin and Leloir is exceedingly rare and is caused either by extension of the lupoid ulceration into the interior of the mouth or by contagion due to the drawing of the tongue over the infected lips. In appearance

the lupoid ulcer is a crusted sore without surrounding inflammation when the crust is removed a nodular or mammillated area is exposed with perhaps some small caseous foci, the general colour being bluish pink.

The true ulcer as has been explained above occurs in very many different forms The pure tuberculous ulcer is oval in shape with a pale, flabby anæmic surface the granulations having a glistening, watery appearance the edges are sloping not everted or indurated and rarely undermined The anterior part of the dorsum is the usual situation of the ulcer the margins being often involved Occasionally caseous areas may be seen. There is no surrounding inflammation This type represents the unmixed tuberculous infection there are also dozens of different varieties, some with induration some with surrounding inflammation and œdema others with a large foul sloughing surface but no useful end is served by trying to classify these diverse appearances. Suffice it to say that in a doubtful case a careful clinical examination of the lungs and a microscopical examination of the ulcer will be required to make the diagnosis clear

The adjacent set of lymphatic glands which drain the affected area are enlarged

Symptoms.—Tuberculous manifestations are usually painful when ulceration has occurred indeed in some cases there is excruciating pain, and the misery of tuberculous disease in this situation may be compared to that which results from tuberculous infection of the bladder There is a tendency to profuse salivation and in neglected cases the mouth becomes exceedingly foul

Prognosis.—Most authorities agree in giving a very gloomy prognosis. Butlin asserts that the disease is usually fatal in from one to two years, and he goes on to say that " the patient is to be regarded as fortunate if he is relieved by rapidly progressive tuberculosis of the internal organs before the ulcer of the tongue has become larger and painful " Pouzergues and Ducrot take a more hopeful view

If a primary lesion can be removed, or if an early secondary infection can be radically treated and the pulmonary disease checked by appropriate remedies, there is some hope of the picture being a little brighter in future.

Treatment.—The main line of treatment is operative. All tuberculous manifestations should be freely excised, unless pulmonary disease or other constitutional debility is a contra indication. The question of the wisdom of operating in the presence of active pulmonary tubercle must be left to the discretion of individual surgeons but if by performing a comparatively simple operation we are able to prevent the pain and suffering which the progress of the ulcer entails, we are entirely justified in pursuing that course. Even in the presence of

the infected sputum healing does occur The enlarged glands should also be removed

Cases which are not submitted to operation should be treated like those of chronic glossitis (p 190 *et seq*) or simple ulcer (p 196) Soothing, weak astringent mouth washes are to be preferred, and caustics are to be avoided

It may be necessary to give all food finely minced so that its prolonged presence in the mouth for mastication may not be needed

Cocaine and orthoform are useful applications, but the first must, of course be used with care.

An application to the ulcer of iodoform 1 gr morphia [illegible] gr borax 3 gr by means of a soft brush is advisable after the surface has been gently cleaned with cotton wool A bismuth ointment is sometimes valuable as an alternative

SYPHILITIC DISEASES

The tongue may be attacked by syphilis in any of the three recognized periods of the disease and the frequency with which the organ suffers makes it a valuable signpost in cases of doubtful syphilis. As in other parts of the body these syphilitic manifestations copy *often in a very accurate manner the appearances produced by other* pathological conditions, so that the possibility of a lesion of the tongue being syphilitic must always receive due consideration. At the same time it will not be out of place to quote Butlin s warning in this respect

Nothing leads to greater errors in diagnosis and treatment than the tendency to see syphilis in every form of obscure affection of the tongue, or to persist in a diagnosis of syphilis when a short and vigorous administration of antisyphilitic remedies has proved of no service."

Chancre

The initial lesion of syphilis is occasionally found on the tongue Fournier discovered it here 53 times in 642 cases of *extragenital* chancre. The infection is conveyed by direct personal contact, or indirectly by the use of cups, pipes, glass blowing and other instruments contaminated by infected persons. As a rule the chancre is situated on the anterior part of the tongue and, as in the case of the genital affection may or may not show well marked ulceration

The **pathology** of the lesion is the same here as elsewhere there is extensive proliferation of the fixed connective- [illegible] ls of the subepithelial layer some infiltration of leucocytes, a[illegible] ng of the arteries and veins. [illegible] changes cease fairly [illegible] at the margin the chancre [illegible] hard nodular [illegible] in the normal *supple tongue.* [illegible] *of ulceration* [illegible] ly depends upon the extent [illegible] epithelium is

the degree of mixed infection that has occurred and upon the presence or absence of trauma

The smooth chancre appears as a firm hard well-defined nodule aptly compared in shape and feel to a nux vomica seed embedded in the tongue The ulcerated form has a characteristic appearance like the bowl of a spoon the induration being accompanied by more infiltration than in the preceding variety and by pain and salivation A fissured chancre has been described

Within ten days of the appearance of the primary lesion the submaxillary and submental lymphatic glands will be found enlarged and as so often happens in the glandular enlargement associated with an extragenital chancre the degree of swelling is considerable and relatively greater than that of inguinal adenitis in genital chancres.

The characteristic induration the glandular enlargement, and the short history of the lesion make the **diagnosis** easy but it is always advisable to examine for spironemas in a doubtful case it may be necessary to try Wassermann's test or even to wait for symptoms of the generalized disease before a definite opinion can be given.

Active **treatment** must be undertaken as soon as the diagnosis has been made a mercurial mouth wash should be ordered, and iodoform powder may be applied occasionally to the ulcerated varieties.

The infectious character of the disease in this and in the secondary stages should be pointed out to the patient.

(*Soft chancre of the tongue* has been described by Emery Sabouraud and Fournier)

Secondary Stage

In this stage mucous nodules or patches are met with which present the characteristic pathological features of syphilitic lesions, arising from localized proliferation of the connective-tissue cells the resulting elevation being covered with thickened epithelium.

The proliferation of the connective-tissue cells extends over a wider area than in the primary lesion and does not proceed to the same degree of development, the resulting papule or projection only just standing out from the surface of the tongue

Influenced no doubt by the agencies referred to above the surface of the patch may ulcerate even deeply and the so-called secondary ulcer may be formed. These patches may be met with anywhere on the tongue or fauces but they are more common on the dorsum in front of the circumvallate papillæ they are also found on the under-surface.

In their course they arise as small nodular elevations the size of a pea and gradually extend to the size and shape of an almond. The

great service and it may be stated generally that the oral and lingual manifestations of syphilis are rapidly benefited by a course of salvarsan

CYSTS AND TUMOURS

DERMOID CYSTS

The group of cystic tumours in the tongue to which the term dermoid may be applied consists of three main varieties, depending upon the particular developmental irregularity responsible for their formation

In this consideration we must take into account the changes which occur in the developing neck. In the middle line of the neck, where the lateral folds meet one another in the process of fusion portions of the epidermis may become unnaturally included in the underlying mesoblast, and may later develop into the type of cyst called by

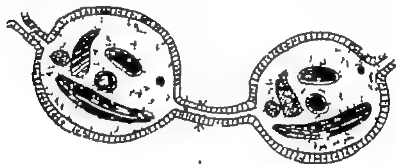


Fig 336.—Branchial arches and cleft.
External cleft depression 2, internal cleft depression 3, cleft membrane.

Bland-Sutton *sequestration dermoid* such dermoids may be met with embedded in the substance of the tongue.

Again if the process of obliteration of the branchial depressions by the opercular folds of the cervical sinus be imperfectly carried out, embryonic remains may later develop into cystic tumours. Between each branchial bar and the next there is a depression or cleft recess, limited by the cleft membrane—the outer part, or external cleft depression, being lined by epiblast the inner or internal cleft depression by hypoblast (Fig 336) Dermoid cysts arising in connexion with the external cleft depression present all the usual characteristics of a dermoid cyst being filled with pultaceous sebaceous matter and having typically epidermal walls upon which hairs may be found. Cysts arising from the inner cleft depression extremely rare appear rather in the form of pharyngeal diverticula or more rarely as cystic

tumours *containing glairy fluid*, and in most cases some connexion with the pharyngeal wall can be discovered

Strictly speaking such dermoids as these do not occur primarily in the tongue being generally found in the submaxillary region from which, by extension they may invade the lingual substance.

The third variety is the one which develops in connexion with the median thyroid rudiment (Fig 337) such cysts or it may be solid tumours occur deeply in the posterior part of the tongue, this form *is called by Bland Sutton a tubulo-dermoid*

SEQUESTRATION DERMOIDS

These cysts usually occur in the anterior part of the tongue in the middle line, and *are then situated* between the two genio hyo glossi sometimes they are laterally placed, but this is owing to their irregular extension, or more *probably to* the cysts having arisen in a branchial recess. Such *cysts* grow slowly and protrude either into the mouth or into the submental region, in advanced cases a very large swelling may be formed which renders closure of the mouth *impossible. The swelling has a curious doughy feel pits* on pressure and in some cases is of a yellowish colour

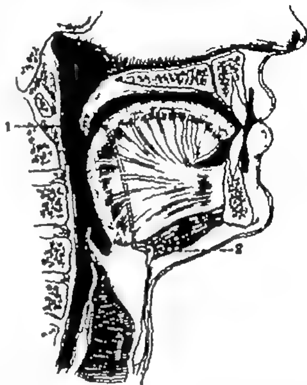


Fig 337 —Diagram showing position occupied by thyroid tumours and cysts in the base of the tongue, indicated by the double dotted line.

Foramen cæcum a, hyoid bone

If the cyst has been allowed to rupture or has been incompletely removed dermoid *fistulæ* form and discharge the sebaceous débris and hairs found in these cavities the cavity usually becomes infected, and the contents may be horridly fetid.

In a case under my care, a French boy complained of this offensive discharge, but at first nothing could be detected on examination of the mouth. Closer inspection however showed a few fine hairs projecting from the side of a fistula in the position of the submaxillary papilla. A probe passed into a deep cavity let out a quantity of very offensive sebaceous matter an attempt was made to destroy the cyst wall, and this failing, the cyst was completely dissected out after division of the mandible

Treatment.—Dermoid cysts must be excised, either through the open mouth or if large, by an incision below the jaw (Regnoli's incision, p 239). As a rule they shell out easily by blunt dissection, though they are usually adherent to the hyoid bone at one point.

Sometimes great difficulties from surrounding inflammation are encountered, rendering a laryngotomy or a tracheotomy necessary while, if the cyst has ruptured, the dissection of the sinus is a matter of the greatest trouble, and may as in the case recorded above necessitate division of the jaw at the symphysis The whole cyst wall or fistulous track must be removed, or the operation will be a failure. The cavity should be plugged with iodoform gauze kept clean, and allowed to heal up from the bottom.

Lateral dermoids are treated in the same way

Tubulo-Dermoids Thyro-Dermoids or Thyro-Glossal Dermoids

These growths are found at the back of the tongue in the region of the foramen cæcum, or deeply embedded in the posterior part of the tongue substance. When situated near the surface they are more often solid than when placed more deeply As in the case of the thyroid gland itself we meet with adenomas in which there is no cystic change, and with others in which the whole tumour undergoes a cystic transformation, so in the thyroid tumour of the tongue it is a mere chance which variety will occur

These cystic tumours are generally regarded as retention-cysts of the thyro-glossal duct, and as such are infinitely commoner below than above the hyoid bone in actual fact, however we are hardly justified in putting this interpretation on their origin since there is no evidence to show that the thyro-glossal duct was ever a functional canal for the purpose of conveying secretion into the mouth It is rather the track of the developing thyroid, and would be better called the thyro-glossal tract, along the course of which aberrant thyroid particles may develop into cysts or tumours. The thyro-glossal tract, indicated in Fig 338 by a thick black line, passes from the foramen cæcum through the base of the tongue to the hyoid bone It usually runs behind, but occasionally in front of this bone, and

in rare instances through it. Thence it extends down in front of the thyroid cartilage.

When these thyroid tumours develop at the base of the tongue they are often solid and consist of vascular thyroid tissue exceedingly prone to bleed; severe and even fatal hæmorrhage has occurred spontaneously or as the result of incautious puncture. Cystic change may occur and this is no doubt the origin of the so-called blood-cysts of the tongue.

Treatment.—Thyro-glossal cysts should be completely excised; this entails a dissection of the tubular canal which may be found extending from the thyroid gland up to or even beyond, the hyoid bone. Incomplete removal is always followed by recurrence. Although it is rarely necessary to continue the dissection beyond the hyoid bone into the tongue substance the operator must be prepared to do this, even dividing the hyoid bone if necessary.



Fig. 229.—Diagram showing a thyro-glossal tract.

Thyro-glossal tract; 2, hyoid bone.

No treatment should be undertaken in the case of the solid thyroid tumours at the base of the tongue, unless they are the cause of trouble. Not only is an operation for their removal attended by a considerable amount of danger but in some cases these tumours consist of the only functional thyroid tissue which the patient possesses, and removal of them has been followed by cachexia strumipriva. If, however they give rise to serious hæmorrhage from ulceration or difficulty in swallowing or breathing, they must be removed. When projecting from the surface and especially if somewhat pedunculated, they may be snared off with a cautery wire.

The more deeply situated tumours must be dissected out. Rose's

position (p 233) the head hanging over the table, may be sufficient in some cases, but in others the upright position with division of the mandible will give better access. Again a preliminary laryngotomy may be advisable In every case, care must be taken to check all hæmorrhage and to bring the edges of the cavity together with deep sutures.

After treatment as in operations for cancer must be carried out.

Other cystic conditions which have been described are *mucous cysts* from distension of the mucous glands, and *parasitic cysts* from the deposit of the *Cysticercus cellulosa* or of echinococcus parasites.

MACROGLOSSIA, OR ENLARGEMENT OF THE TONGUE

The several causes of enlargement of the tongue fall conveniently under the following headings —

1 Lymphangiomatous
2. Muscular
3. Inflammatory
4 Syphilitic.
5 Mercurial.

1 Lymphangiomatous Enlargement

This, the most usual form of macroglossia, is caused by a dilatation of the lymphatic spaces, with subsequent thickening and induration of the lingual tissues. The condition is usually congenital, but it is not invariably present at birth in some cases, indeed, it is not noticed until several years after

Pathology—The normal lymph spaces of the tongue (the anterior three-fourths) are increased in size and in number This change has generally been ascribed to some obstruction to the efferent lymphatics of the tongue, so that the existing spaces become distended. It is not by any means clear that this is the sole cause, and from the progressive spread of the disease it has been suggested, with a considerable amount of reason, that there is an actual overgrowth of the lymph spaces and tissues in the tongue substance constituting an actual lymphangioma or new growth. Hutchinson suggested the term "infective lymphangioma" analogous to lupus lymphaticus, to explain its progressive course, but it is simpler to regard the condition as comparable to nævoid or angiomatous growths of the veins and capillaries, affecting in this instance the lymph rather than the blood vascular system.

Virchow compared the disease with elephantiasis and the similarity is great at the same time, the occurrence of macroglossia among the sufferers from elephantiasis Arabum is exceedingly rare

Precisely the same pathological phenomena will be observed if the lymphatic tissues of a part enlarge to such an extent that the existing lymphatic vessels are unable adequately to drain the region as if those vessels were the site of an obstruction preventing them from draining in normal circumstances.

In some cases a definite injury has preceded the development of macroglossia. Stone records a case of this kind.

The microscopic appearances have been carefully described by Butlin to whom we are indebted for the following accurate account :—

"If a vertical section be made of a simple lymphangioma, the lymphatic spaces immediately beneath the epithelium are dilated; by further enlargement the lymph space bulges towards the surface, thinning the epithelium by pressure until only a layer of corneous epithelium covers the surface. The contents of the space are lymph-serous fluid containing numerous white corpuscles.

"By extension between the muscular fibres and fusion of the lymph spaces large cysts are formed, so that the portion of the substance of the tongue invaded has a honeycombed look. Around these dilated lymphatic spaces three changes take place, and it is in accordance with the relative proportions in which each occurs that the differences found in advanced cases are due. These are—(a) dilatation and new formation of blood vessels; (b) inflammatory changes with formation of fibrous tissue; (c) new growth of lymphadenomatous tissue.

"(a) The capillary loops between the vesicles in the simple form develop into arteries, thin-walled, coiled, and of a considerable size. The veins also increase in number and become dilated. Then the blood vessels rupture into the large lymphatic spaces, which become distended, partly by blood clot, partly by circulating blood. In this way is produced the cavernous form of macroglossia (Barker, Hutchinson, jun.).

"(b) The dilatation of the lymph space is accompanied by inflammation. Small round cells infiltrate the connective tissues, and tough fibrous tissue increases and slowly surrounds the spaces. The inflammation is subject to sharp fluctuations, a marked increase accompanying the extravasation of blood; then it subsides, but to recur again and again. With each attack there is a further formation of fibrous tissue, which permanently enlarges the portion of the tongue affected, and gives the enlarged tongue a tough or almost wooden feeling, varying with the amount of œdema in the fibrous tissue.

"The fibrous tissue presses aside the muscular fibres and causes them to degenerate, so that, whilst the tongue enlarges, the amount of muscular substance is being continually reduced, until it disappears altogether from the affected portion of the tongue. The section shows simply fibrous tissue with a variable number of spaces containing either lymph or blood.

"(c) Small round cells collect in the connective tissue between the muscular fibres, amongst the lymph spaces; and between the cells retiform tissue may be met with. These small round cells are not replaced by fibrous tissue, but a new growth goes on slowly until lymphadenomatous masses are produced. A macroglossia may even terminate by the development of a small round-celled or lympho- sarcoma."

Clinical features.—The first symptom which attracts attention is an increase in the sensitiveness of the organ accompanied

by the development of minute cysts or blisters, which readily rupture (Plate 87) At first only a portion of the tongue is affected, but the process spreads until the whole organ is attacked. From time to time there are outbreaks of acute inflammation, which leave the tongue larger and firmer than before.

At first the tongue is concealed within the mouth, and shows, on inspection, general enlargement with hypertrophy of the papillæ gradually however with the increasing size there is difficulty in retaining it within the oral boundaries the saliva dribbles away and the tongue protrudes, its surface, from exposure to the air becoming hard, brown cracked and fissured Progressively the bones of the oral cavity become affected and in some cases even after proper treatment of the affected organ, closure of the jaws may be impossible.

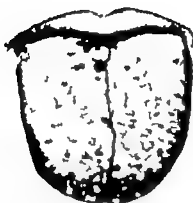
Treatment consists in freely removing part of the organ by means of a V-shaped cut and suturing the edges of the wound together A sufficient amount should be removed to allow the tongue to lie easily within the mouth and at the same time the operator must bear in mind that he is dealing with a form of new growth, and he should therefore endeavour to cut wide of the morbid tissue, otherwise recurrence in the stump is likely to ensue. The operation is attended by profuse bleeding, and steps must be taken to deal promptly with the hæmorrhage.

In the case of very young children it may be wise to postpone the operation for some years, as its performance has been fatal. The child should be spoon fed—it cannot suck—until sufficiently strong to stand what may be a formidable surgical procedure and then subjected to the operation.

2. Muscular Macroglossia

A true muscular hypertrophy in which there is an increase in number and size (Helbing) of the muscular fibres is occasionally seen. Such a condition may occur in a normal individual the lingua vituli more usually it is met with in cretins and congenital idiots. *In some cases the enlargement may be unilateral.* It may be associated with abnormal enlargement of other parts of the body and is therefore part of a gigantism or increased growth of the individual, probably the effect of some obscure nervous influence.

Treatment.—The activity of the treatment must depend upon the amount of inconvenience resulting from the deformity Treatment is not to be undertaken so readily as in the former variety since the progress of the growth is slow and there are none of the characteristic features of a "new growth" present. Occasionally the two forms are combined, in which case early radical treatment is indicated.



Lymphangioma of dorsum of the tongue, which was beset with clear vesicles, between which were scarlet capillary loops and blood filled vesicles. A few of the vesicles were filled with opaque, white material. The condition was associated with a capillary nævus involving the lower lip and about half an inch of skin surface parallel to the muco-cutaneous margin, and extending across the alveolar margin to the under surface of the tongue, where there were some dilated veins.

(*E. Rock Carling coll.*)

PLATE 87

If operation becomes advisable in the pure muscular variety it should consist in removal of a wedge-shaped piece of tongue rather than in ligation of the lingual arteries—a method which is neither certain nor safe.

3, 4, 5. Inflammatory, Syphilitic, and Mercurial Enlargements

Inflammatory enlargement is merely the result of an acute glossitis, after which a large indurated area may be left.

Syphilitic hypertrophy has been considered in connexion with syphilitic parenchymatous glossitis (p. 207). The condition calls for no special treatment.

With regard to mercurial enlargement, it should be remembered that excessive use of mercury in syphilis tends to exaggerate any existing hypertrophy, and that the drug may even produce an inflammatory enlargement by its own action.

INNOCENT TUMOURS

The tongue is rarely the seat of a simple growth—a marked contrast to its ready tendency to undergo malignant change. Innocent tumours of many varieties have been described, such as *lipomas*, recognized by their yellowish colour when superficial; *fibromas*; *chondromas*; localized or general *lymphangiomas*; *neuro-fibromas*; *myomas* of both striped and unstriped types; *amyloid masses* in the subjects of chronic bronchitis and emphysema; and even *osseous tumours* and those of a *teratoid* nature. Many of these growths are of the greatest rarity and may be regarded as being more of pathological interest than of clinical importance. In general they will be treated by removal if the tumour appears to be a source of discomfort or danger.

Vascular Tumours

On the other hand, the vascular tumours are not only a good deal commoner than the preceding, but since they may be the source of dangerous hæmorrhage they must be specially considered.

Among the vascular tumours, examples of *arterio-venous aneurysm* have been met with, as the result of injury. They have occurred usually on the floor of the mouth and have been treated by ligation of the lingual arteries. A few instances of *cirsoid aneurysm* have been recorded, one half of the tongue in the published cases being occupied by large tortuous arteries which bled violently as the result of injury.

NÆVI

Nævi, both capillary and cavernous, are much more common. The *capillary* form may be congenital in origin, or may appear later

possibly as the result of injury Capillary nævi bleed readily and profusely and in this respect are similar to the small but dangerous capillary hæmorrhoids described by Allingham.

The *cavernous* nævi usually found on the anterior part of the tongue may attain some size, and may be associated with a similar state of the lip and cheek. They are quite painless and as a rule circumscribed, but they have an unfortunate tendency to increase in size and are liable to bleed profusely if injured. A cavernous nævus is recognised by its dark colour and soft consistence, in addition to the enlargement of the vessels in the neighbourhood

Treatment.—Nævi should receive active treatment, as there is always a risk of severe bleeding, which cannot in all cases be readily controlled. Capillary or even small cavernous nævi should be treated by the galvano-cautery—the point, at a dull red heat, being thrust deeply into the spongy tumour The application must be repeated until the blood spaces are finally obliterated. Electrolysis is often of use in these cases

In more extensive and diffuse cases excision is indicated by means of a wedge-shaped cut placed well outside the line of the nævus, care being taken to secure the larger vessels as they are cut. As a preliminary measure one or both lingual arteries may require ligation

VARICOSE VEINS

May be met with in the tongue as in other parts of the body some degree of varicosity is usually associated with nævi. As a rule no treatment is required especially when the posterior part of the organ is affected, as there is little danger here of injury and bleeding. In the anterior part, if increasing in size they should be treated as nævi, of which very often they form a part.

PAPILLOMAS

These growths are found chiefly on the dorsum, and are in many cases congenital They may be single or multiple

Irritation unquestionably plays a part in the production of a certain number of papillomas. One variety found on the side of the frænum from contact with the incisor teeth in whooping-cough, appears to follow the development of an ulcer which is commonly present in this situation

Tongues which are the seat of chronic superficial glossitis are prone to develop large sessile papillomas, which must be regarded as examples of local irritative hypertrophy

Warty growths also occur in syphilis.

Treatment.—Papillomas should be excised or if small, destroyed completely by the galvano-cautery The inflammatory papillomas

are unquestionably liable to become cancerous indeed it is sometimes impossible to distinguish clinically between the simple tumour and one that has already undergone a malignant change. They should be removed by elliptical incisions which pass deeply into the tongue, and the edges of the wound should be sutured.

MALIGNANT TUMOURS

Sarcoma [1]

Primary sarcoma of the tongue is rarely met with and probably many of the recorded cases do not properly fall under this heading Microscopically the tumour may consist of round or spindle cells, and in most cases there is a very well-marked history of injury or prolonged irritation.

The degree of malignancy in the recorded cases varies so enormously that it is, perhaps, too early yet to speak with decision of the diagnosis and treatment of sarcoma of the tongue.

In some cases the growth appears distinctly encapsuled, as do sarcomas elsewhere in the body In other cases the tongue is extensively invaded and the growth soon spreads to the lymphatic glands.

Lympho-sarcomatous tumours originating in the lymphoid tissue at the base of the tongue have been described, and seem to form the most malignant variety The large round-celled tumour grows much more slowly while slowest of all is the fibro-sarcoma that pathological cross-breed, midway between the fibroma and the malignant growth.

With regard to **treatment**, we may repeat what has been said above in connexion with simple tumours. All new growths of the tongue should be removed If the rate of growth of a tumour suggest a sarcomatous nature or if there be recurrence after removal of a doubtful tumour an attempt should be made to extirpate the disease by cutting widely into the healthy tissues beyond the limits of the growth. Glandular involvement, which has been a not infrequent concomitant in reported cases, will be a contra-indication to operative treatment, unless there be a good prospect of getting wide *of the disease.*

Endothelioma, or Endothelial Sarcoma [1]

Tumours of this nature starting in the lymph spaces or blood vessels of the tongue have been described by Eve and others They appear to vary much in malignancy in some instances growing slowly and causing a local invasion only At the present time much uncertainty exists as to the exact nature of some of the tumours which have been described as endotheliomas. Here as

[1] *See also* Vol. I., p. 5..7

elsewhere, there appears to be a growing tendency on the part of pathologists to classify as endotheliomas many of the growths which have been hitherto accepted as carcinomas. Only one instance of the kind has come under my notice a nodular tumour unaccompanied by marked ulceration, occupying the posterior part of the right side of the tongue in a man of 60 was removed locally and submitted to microscopical examination the report stated that the structure was very unlike carcinoma, and that the condition was one of endothelial sarcoma. The patient refused the extensive operation that was proposed

More information is still required on this subject, the chief difficulty at present being our inability to distinguish with certainty by microscopical examination between connective-tissue and epithelial cells.

Carcinoma[1]

Few parts of the body are so susceptible to malignant change as the tongue, and in no position is its occurrence more distressing to the patient, or more trying to the surgeon, although at first sight it would appear more favourable to radical treatment than growths in many other situations.

Of all cases of cancer in the male sex, about 8 per cent. are cases of cancer of the tongue, according to the figures given by Butlin and Jessett while on comparing the relative frequency of the disease in the two sexes, allowing for some slight variations, the figures work out at 85 per cent. males to 15 per cent. females. This greater frequency in the male sex is no doubt due to the fact that the precancerous states induced by irritation and disease are commoner in the male than in the female.

Although the "cancerous" age may be taken as beginning at 40, cases of very malignant cancer have been recorded in quite young subjects—Variot has recorded a case in a boy of 11 Billroth in a patient of 18 while out of 290 cases recorded by Barker in 8 the ages of the patients lay between 20 and 30. Nor does old age confer immunity although after 70 the incidence of the disease is rare. O Weber *has observed a fatal case in a centenarian.*

Etiology Predisposing causes.—Whatever the future may have to show as to the cause of cancer in no situation do the predisposing causes of irritation and inflammation play such an important part in encouraging the disease as in the tongue and until our knowledge of the actual cause becomes more exact we must devote our attention specially to those factors which influence the incidence of a cancerous change.

It is now universally acknowledged that the chronic conditions of

[1] *See also* Vol. I., p. 565.

leucoplakia, and syphilitic fissuring, and unhealed ulceration are liable to become malignant. A tongue which for years has been in an unhealthy state and in which there has been an irregular proliferation of epithelial and connective-tissue elements is exactly the kind of soil in which the cancer cell grows and flourishes. This "precancerous condition" as it has been called has attracted wide attention and it is now recognized that chronic patches, inflammatory papillomas, or indurated fissures which do not subside under appropriate treatment should be dealt with surgically. We are as yet ignorant of the cause which converts these wavering tissues into actual cancer; but we know that the irritation of carious teeth and ill fitting tooth plates and the incautious use of caustics have a very serious effect. Butlin's dictum with regard to caustics should be quoted in full: "If there be one thing more harmful than another in the treatment of a simple indolent sore and affections of the tongue in persons over 30 years of age it is the application of a strong caustic."

Smoking has always been credited with a considerable degree of importance in the production of cancer of the tongue, and it may act by first producing a condition of leucoplakia, then by additional irritation urging that on to a cancerous stage. It is probably the kind of smoking indulged in that is of special importance: "hot smoking" with short pipes, and especially rough-stemmed pipes, such as clays, is more dangerous than other forms.

Syphilis is another predisposing cause not only from its tendency to produce chronic inflammatory conditions, but from its liability to leave thin, unstable scars or fissures which readily become the seat of carcinoma.

The position with regard to our present knowledge of the etiology of cancer may be summed up as follows. There exists under normal circumstances a "balance of power" between the epithelial and connective tissues of the body, possibly between individual cells also. In parts which are the subject of chronic inflammatory processes or subjected to prolonged irritation that balance is disturbed, either in the shape of abnormal activity conferred on one cell element, the epithelial, or a diminished control on the part of another, the connective-tissue. Then comes the actual exciting cause, which we have yet to discover, whether a parasite or some peculiar inherited property possessed by the cells; it is here that the border-line which separates the precancerous from the cancerous stage is passed, a border-line indistinguishable by the clinical eye and not always clearly defined to the pathological. From now onwards it is an unequal fight. The cancerous epithelial cells are pitted against the resistant power of the connective-tissue cells and the victory is nearly always with the former. In order that in future our treatment may be successful, we

must operate at the earliest possible moment by surgical activity in the unstable precancerous stage we may hope to avert a malignant catastrophe, while by extensive operations along modern lines when the disease has declared itself we may hope to improve results which in the past have been indeed deplorable.

Pathology—Most cancers of the tongue are squamous-celled epitheliomas, due to the downgrowth of epithelial columns from the surface. Steiner has recorded a case of columnar carcinoma. Starting from the surface, the cells penetrate between the muscular fibres in a series of vertical columns which tend to anastomose and to develop cell nests it is the presence of a number of these cell-nests, due to a corneous degeneration of the central cells of the tubular down growth, which conclusively denotes a cancer on section. This spread is accompanied by an active proliferation of round connective-tissue cells at the periphery a reaction which we must regard as in part protective, a poor attempt to limit the relentless growth. It is the connective-tissue proliferation which produces the "infiltration" of the tongue substance, and is also responsible for the fixation of the organ that occurs at a later date.

The superficial cells of the growth degenerate, and thus give rise to surface ulceration. Those cases in which the growth appears as a nodule in the tongue substance are examples of delay of the degeneration and consequent ulceration.

In some instances the growth and spread of the epithelial cells is extraordinarily rapid, and the term medullary carcinoma is applied. In others the process is slow and is accompanied by the development of mature fibrous tissue from the active connective-tissue cells surrounding the downgrowth of epithelium this form is sometimes referred to as the scirrhous type. The importance of these varieties in course and prognosis will be considered later

Glandular infection.—Sooner or later the cancer cells detached from the primary focus find their way into the lymphatic channels and reach the glands which drain the region These have already been described (see p 178) The glands, when attacked, increase in size, and at first appear as hard movable masses tending later to fuse and to undergo two special changes which are peculiar to secondary cancer of the tongue, mouth, and lip, namely cystic degeneration and suppuration. The cystic change is mainly the result of necrosis of the central cells; suppuration is due to a bacterial infection which accompanies the cancer cells to their destination in the glands.

Clinical appearance and classification.—Cancer of the tongue appears in a number of different forms, the variation being due, first to the primary condition of the organ in which the growth

has started secondly to peculiarities in the growth itself thirdly to the amount of resistance that it encounters on its way

1 *Papillary form* —Two varieties are seen (1) The small indurated papillomatous cancer which has started in a plaque or neglected leucoplakial patch, and is only recognized by its induration Very often a deep fissure can be seen traversing the papillary area. (2) The large fungating cauliflower-growth. I have seen two marked cases of this form. The appearance at first sight did not suggest a cancer but rather a benign papilloma There was, however a history of rapid growth, and the mass was much larger and whiter than is usual with the simple papilloma In both instances there was a curious absence of induration. The diagnosis of cancer was confirmed by microscopical examination, but in each instance there was rapid and fatal recurrence after operation. I regard this type as exceptionally malignant.

2 *Nodular form* —The nodular type is somewhat rare. It appears as a hard nodule or plaque which seems situated in the tongue substance closely simulating a primary chancre. There is little or no ulceration because the degenerative process is not pronounced. In a case of this kind under my care I was very doubtful of the diagnosis until I had removed the mass and submitted it to microscopical examination. On squeezing the mass before excision, I made caseous matter ooze from a small opening on the surface, and thought I had to deal with a chronic inflammatory mass, possibly caused by a foreign body The pathologist s report left no room for doubt.

3. *Ulcerous form*.—This is the common variety but here again the ulcer may present itself in a number of different guises, depending upon the rate at which it spreads, the presence or absence of an active bacterial infection, or upon the particular type of ulcer such as a dental ulcer on which the cancerous process has been grafted.

The chief characteristics of the typical cancerous ulcer are as follows It is usually situated at the side of the tongue very commonly at the posterior part, and the tongue, being fixed by the infiltration is protruded with difficulty In advanced cases the patient may not be able to open his mouth widely There is an abundance of saliva which runs away when the mouth is opened.

The surface of the ulcer is usually foul and covered with food, bacteria, and epithelial débris the edges are raised, and for a distance of a quarter of an inch or more the thickened epithelium of the margin stands out as a white or yellowish white band from the surrounding normal cuticle This peripheral thickening of the epithelium is present in epitheliomas of the lip and is an important detail.

On passing the finger over and round the ulcer the edges feel hard and indurated, like cartilage while a mass can be detected

in the tongue substance continuous with the ulcer The surface bleeds readily on examination,

If the mouth has been kept clean, and especially if, with the idea of cleaning up a dental ulcer washes have been ordered or iodide of potash prescribed the appearance may be different.

The surface of a foul ulcer readily cleans under proper treatment, and sloughs and offensive smell may both be absent.

4 **The fissured form** commences in the cracks or clefts left after chronic glossitis, syphilis, and more rarely tuberculosis. Fissured cancer is uncommon, and is difficult to diagnose in the early stages the chief features being the callous character of the ulcer and the induration of its edges.

5 **Indurative form** ("wooden tongue") —The whole tongue becomes peculiarly fixed, shrunken and hard, often perhaps as the result of previous inflammatory changes. The amount of ulceration present may be quite slight and may be overlooked when situated at the posterior part.

An attempt has thus been made to describe the chief clinical varieties of the disease and it may be well to emphasize again the fact that ulceration, although usual, does not invariably accompany the development of cancer

6. **Double epithelioma.**—Diffuse and hypertrophic forms have been described.

Situation.—Any part of the tongue may be attacked but the disease is much commoner in the anterior two-thirds. The sides of the tongue, more liable to irritation are also more liable to cancer I have seen a great many cases at the junction of the anterior faucial pillar with the side of the tongue.

Cancers at the back of the tongue are easily overlooked they spread rapidly and deeply and are difficult to deal with.

Epithelioma may infect the tongue from surrounding structures, such as the floor of the mouth, tonsil, and lip, but these will be considered under their respective headings.

Symptoms.—Pain, salivation, bleeding inability to open the mouth, are some of the symptoms which cause a patient to seek relief Pain often referred to the ear is common in cancers at the back of the tongue. The pain in the ear is generally regarded as referred from the lingual to the auriculo-temporal, but it may well be connected with the course of the glosso-pharyngeal or vagus, especially the latter since similar auricular pain is common in cancer of the larynx. Sometimes pain is curiously absent, and the patient comes dissatisfied with the non healing of an ulcer or delays seeking advice until a large fungating mass involves the tongue. Salivation is usually present and troublesome.

Inability to open the mouth is a late symptom and due to the infiltration spreading back into the tonsillar region rarely it is due to reflex pain.

Hæmorrhage in the early stages is always slight, and, even when the growth is advanced, serious hæmorrhage in the primary focus is rare, though it is more common and fatal from the secondary deposits.

Course.—The disease when once established progresses steadily to a fatal termination within one or two years, unless arrested by operative treatment. In some cases death has occurred as early as five months from the first appearance of the disease.

To the gradual but definite spread of the lingual growth there is added, sooner or later the glandular infection. No exact period can be laid down before which it may be safe to assume that the glands have escaped it is again a question of resistance and virulence. The natural resistance which the tissues are able to offer to the spread of the growth may prevent lymphatic permeation for several months on the other hand, a growth of high malignancy fostered on a fertile soil may spread with appalling celerity to the glands and involve them extensively Nor again are we able accurately to determine the state of the glands on clinical examination. In the early stages of their infection the small shotty glands are quite out of reach of the examining finger

It is true that a growth accompanied by sloughing and ulceration will give rise early to inflammatory glandular enlargement, an enlargement which may subside after the growth has been removed, but we cannot with any safety rely on this to help us, for cancer cells may have settled in the glands at the same time as the bacteria and if the glands are left, these cells will, by their progressive development ultimately render an operation for their removal imperative—an operation which perhaps has been most unwisely deferred.

In all cases in which cancer in the tongue is proved we must assume infection of the glands.

If the case is seen too late for operative treatment, there is nothing to look forward to but a horrible, lingering agony to which the final complication comes as a great relief. Progressively the ulcer increases in size food is taken only with difficulty pain fetor and salivation combine to render the patient unbearable to himself and to those who surround him the glands enlarge, break down and ulcerate and death is happily ushered in by a fatal hæmorrhage or a low form of pneumonia. Probably few have watched the final struggles of these exhausted patients, and only those who have can realize the extent of the misery which the disease entails. It is well that this should be fully appreciated before a decision is arrived at that a case

is inoperable, since even if only the primary growth can be dealt with, death from glandular recurrence is infinitely less painful.

The rapid spread of lingual carcinoma has been explained by Heidenhain as due to the contractions of the lingual muscles, which are constantly forcing on the cancer cells but, apart from the glands, dissemination to a wide extent is uncommon probably because the patient dies from the lingual or glandular disease before extensive metastases can form.

Diagnosis.—A certain diagnosis in cases of early carcinoma of the tongue is impossible without the aid of microscopical examination. In the more advanced cases the pain, induration thickened epithelial margin, fixation, and glandular enlargement all indicate malignant disease. The chief difficulty will be experienced in distinguishing between carcinoma on the one hand, and a chronic ulcer from irritation a gummatous ulcer and perhaps more rarely tuberculosis on the other. A careful examination should be made of the mouth to see whether a local cause, such as a rough carious tooth or an ill-fitting tooth-plate exists. Careful inquiries into the history should be made and the lungs should be thoroughly examined. If this investigation does not throw any light upon the case, no time should be wasted before making a careful microscopical examination of the margin of the growth for this purpose it may be sufficient to snip off a small piece after the part has been painted with a 5-per-cent. solution of cocaine, but I am of the opinion that it is far wiser to cut out a fair piece of growth and adjoining tissue I have so frequently seen the futility of trying to form an opinion from a small piece of shrunken tissue. A mere scraping of the growth is, in my view insufficient, even though it show a number of cell nests in order to be certain we must study the epithelial changes in relation to the adjoining connective tissues.

It has been argued that such an examination tends to disseminate the growth, and to excite it into abnormal activity Personally I place no reliance on this statement since once it has been decided to examine a doubtful growth a radical operation can be undertaken almost at once if the preparation of the section is hurried I should regret it extremely if I had performed one of the extensive modern operations for cancer of the tongue on insufficient grounds.

On the other hand, no time should be wasted in trying potassium iodide, unless indeed the clinical condition of the ulcer and the past history should strongly favour syphilis. It is, unfortunately a common line of treatment to combine the administration of iodide of potash with the application of antiseptic lotions to the ulcer Under this combination cancerous ulcers will improve, the fetor and pain diminish, and even the induration will subside to some

extent Lulled into a state of false security patient and surgeon allow valuable time to elapse and then when the true state of affairs is realized, the ulcer is probably much more advanced and less favourable for treatment than it was at first.

If there is an obvious source of irritation let it be removed and let the ulcer be treated with a mild antiseptic and occasional touches of chromic acid strong caustics are never to be applied. If there is no obvious improvement in ten days, remove a piece of the margin for examination as suggested above.

Tuberculosis should be less frequently confused with cancer as it is much rarer and occurs in younger subjects, who are generally sufferers from pulmonary tubercle Nedopil, however cut out several tuberculous ulcers under the impression that they were cancerous. As this is a recognized treatment for tuberculous ulcers, no harm is done provided nothing very extensive is attempted. In a case of my own, in a man of 65 a large ulcer sprang from the side of the tongue crossed the mouth and involved the lower jaw extensively There were hard, enlarged glands in the submaxillary triangle All who saw him agreed that the condition was malignant, and the general appearance certainly favoured this diagnosis. I removed the growth and the glands at one sitting, and he did very well, recovering completely but further microscopical examination showed that the growth and glands were tuberculous.

Prognosis.—Unless a lingual cancer is operated upon, death is certain. Unfortunately the operative results still leave much to be desired. They will be considered later

In considering the prognosis, Trotter lays stress upon the character of the growth, and states that those that tend to grow centrifugally out from the tongue, have a relatively better outlook than those that incline to grow centripetally into the lingual tissues. He regards the proportionately excessive ingrowth as an indication that the neoplasm has overcome the natural resistance of the normal tissues to invasion, whereas in the outgrowing form the tissues are to some extent succeeding in their attempt to extrude the tumour moreover the ingrowing mass is surrounded on all sides by the succulent lingual tissues, and is therefore better supplied with nutriment.

Treatment.—Cases of carcinoma which come for treatment fall into four main groups —

1 The condition is inoperable it is not reasonable to attempt to remove even the primary growth palliative measures alone must be employed.

2 The condition is too advanced to permit of complete extirpation, but local removal of the primary focus may be attempted with the

view of prolonging life and averting some of the horrible terminal complications. This applies especially to carcinoma situated in the posterior part of the tongue.

3 There is a good or reasonable chance of clearing away the disease. Here each case must be judged on its merits, and the opinion of different surgeons will vary as to what may be considered operable or otherwise. No absolute rules can be laid down. Extensive and fixed glandular metastases will contraindicate a complete operation. Extensive local spread may do the same, but with the knowledge of the certain fatal issue and its attendant sufferings we should be ready to operate on all but the most hopeless.

4 The disease is very early the diagnosis may be doubtful and glandular metastases are not obvious.

The results of operative treatment up to the present have not been very encouraging, largely owing to the fact that the lymphatic spread has only recently been emphasized and appreciated. The trend of modern surgical opinion is towards a free removal of the tongue and a complete removal of the lymphatic areas that drain it.

As a preliminary to any operative treatment, some effort should be made to get the mouth into as clean a state as possible. Absolute asepsis cannot be attained, but obviously carious teeth should be removed or filled, the others should be scaled, and a week may be spent in frequent irrigation of the oral cavity The best solutions for this purpose are weak permanganate of potash, carbolic acid 1 100 bicarbonate of soda 30 gr to the ounce, or peroxide of hydrogen 5 vols. I recommend carbolic acid it is cleanly and sedative, though slightly painful at first. A solution of bicarbonate of soda to alternate with the carbolic is distinctly useful, as it is a solvent of the mucus and allays acid fermentation better than do acid antiseptics. Similar solutions may be used after the operation. Formamint lozenges are valuable.

I advise patients to brush the teeth three times a day and to wash the mouth out well every hour or half hour while they are in the house. At the same time it is not necessary to confine a patient to the house for the whole week he should be encouraged to go out and occupy his mind as far as possible with things around him. These days of waiting may be usefully employed in training him to the use of the nasal or stomach tube, and in accustoming him to swallow from the rubber tube attached to the feeder

If the disease is advanced, the patient should rest in bed, and be fed with stimulating foods, strong soups some alcohol, and possibly nutrient enemas.

If he is old and enfeebled, injections of glucose (6 per cent.) and

normal saline should be given per rectum one pint every four hours during the two days that precede the operation Glucose when so administered has a powerful stimulating effect.

I have had no experience of the use of antistreptococcic serum and cannot appreciate its value unless it is known that the wound is infected with the particular group of streptococci from which the serum was prepared. The blind administration of these serums seems unscientific and unsatisfactory It would be much better in my opinion to take a few cultures from the mouth beforehand and to prepare a vaccine for any obvious growths of streptococci and staphylococci.

OPERATIVE METHODS

In a discussion concerning the various operative procedures for cancer of the tongue the following points have especially to be considered —

1 A preliminary laryngotomy or tracheotomy
2 The preliminary ligation of the blood vessels.
3 The relative order in which the growth and the glands should be attacked.
4. The amount of lingual tissue to be removed.

1 **Should a preliminary laryngotomy or tracheotomy be done?**—The objects which have induced operators to perform this initial step have been first to prevent blood trickling down into the lungs during the performance of the operation secondly to prevent suffocation from the falling back of the stump of the tongue subsequently thirdly to prevent septic pneumonia—the pharynx being plugged for some days the patient is allowed to breathe only through the artificial opening.

The answer to the question must, to a large extent, depend upon the nature of the operation to be attempted. If the more formidable lateral operation of Kocher is selected, a preliminary opening of the trachea may be an advantage, as a large wound is left in the mouth and neck from which discharges may infect the lungs unless the wounded area is kept carefully plugged. There are however other less objectionable measures at our disposal, and there is at present a strong opinion against the performance of tracheotomy

In the milder procedure of Whitehead when only one half of the organ is removed by the intrabuccal method, even a preliminary laryngotomy is not always required. Nor is it necessary in the cases where the median method of Syme is chosen since here the patient's head is propped up the jaw is divided in the middle line and all the blood escapes externally

Again when the vessels are secured during the dissection of the

glands, the final stage of the removal of the tongue is accomplished without any bleeding at all, and in these circumstances *laryngotomy* is not required.

Where the more extensive operations are attempted especially those designed to remove growths situated posteriorly I am strongly *of the opinion that a laryngotomy should be performed*, the entrance to the larynx being firmly plugged with a soft marine sponge. There is no doubt that this preliminary step enables the operator to act with greater deliberation and confidence.

Laryngotomy should be preferred to tracheotomy on account of its greater simplicity and its freedom from complications but if the operator makes his opening in the air passage with the idea of preventing the patient from breathing air which has passed over the oral wound before it is clean, then tracheotomy and not laryngotomy should be performed. A laryngotomy tube is not tolerated for any length of time, and I advise its removal either at the end of the operation or not later than the following day

These arguments advanced in favour of laryngotomy still hold good, always assuming that the operator is unable to avail himself of the services of an expert anaesthetist who can administer an intratracheal anaesthetic. With intratracheal anaesthesia preliminary laryngotomy is unnecessary and this method of anaesthesia is unquestionably the method of choice. Intravenous anaesthesia is not satisfactory in that it often leads to considerable congestion of the vessels of the neck, and favours more extensive hæmorrhage than occurs with other methods of anaesthesia. I have had some experience of rectal anaesthesia but here again an anaesthetist of great experience is required because the administration of the morphia as a preliminary to the ether by the bowel, prevents control of the degree of the anaesthesia, and, certainly in at least one case the death of the patient has resulted from the cumulative effect of these two anaesthetic drugs.

3 **Preliminary ligation of the blood vessels.**—Dawbarn of Philadelphia has written very forcibly on the subject of preliminary or temporary ligation of the blood vessels before attempting an extensive removal of the tongue, and before operations on the mouth and jaws. There is no doubt that this control is largely to the surgeon's and the patient's advantage, though, again, the performance of this step must depend upon the particular procedure to be attempted.

If the surgeon decides to attack the glands in the neck before the disease in the mouth usually when the glandular involvement is advanced, the external carotid and its branches, the lingual and facial, are exposed in the course of the dissection, on one or occasionally

on both sides, and deliberately ligatured the carotid being secured between the lingual and superior thyroid branches. The removal of the tongue may conclude the operation as mentioned below or this final procedure may be deferred. The objection to this is that there is considerable chance of the tongue becoming gangrenous when its blood supply has thus been cut off.

Ligation of the external carotid and its branches ensures occlusion not only of the lingual but also of the facial which gives branches to the tonsillar region.

Temporary closure of the common carotid is practised by Crile in his extensive "block dissection" of the neck, and will be considered later but it is not recommended, as the consequences of closing the vessel, even for a short time, have been very serious.

3. Relative order in which growth and glands should be removed, and the question of removing the glands from the opposite side of the neck.—There is much difference of opinion on these points, and I will briefly review the chief arguments for and against the various procedures.

By primary removal of the lingual growth the mouth can be got healthy and clean, the patient relieved of pain, and when he has recovered from this operation the glands can be removed by a systematic dissection.

As an objection it is urged that such an operation does not remove all the infected tissue since if we are to operate here on the same lines as are practised in the surgery of the mamma, the growth and lymphatics should be removed in continuity

This is certainly a sound objection, but it has been met with the statements (1) that lymphatic infection in lingual cancer is by embolism and not permeation, and that the portions of the lymph system left between the tongue and the glands do not contain cancer cells (2) that the operation is much more severe if both glands and growth are removed in continuity—the cellular tissue of the neck is put into free communication with the mouth, and various septic complications are likely to arise.

If the first of these two statements is correct—and we have no evidence in its favour—there is good ground for separating the two operations. Personally however from the study of sections, I think there is considerable danger of leaving some portion of the growth behind, and pathological opinion favours the idea that this disease spreads by permeation and not by embolism.

Lenthal Cheatle has been kind enough to show me some of the work he has done in connexion with lingual cancer The sections are entirely convincing, and they show a steady spread of the growth by permeation between the muscular fibres of the hyo-glossus in

lateral cancer of the genio-hyo-glossus in median cancer. Recurrence after operation results, in my opinion, from such infected areas being left in the portion of the tongue attached to the hyoid bone, from which situation as it were from a primary focus, the growth is disseminated towards the glands. The tendency of the growth will be to spread away from the mouth and this accounts for the fact that recurrence in the mouth is rare

With such evidence before me, and as the result of my own experience, I have no hesitation in saying that the soundest operation consists in removing glands and tongue simultaneously through a wide incision in the neck. Particulars of the operation will be given later It is a dangerous procedure, however when both sides must be attacked but when only one side is attempted it is very satisfactory and the wound heals well if care has been taken in preparing the mouth.

Many surgeons are of opinion that, having in mind the risks and dangers of the operation mentioned above, the needs of the case are adequately met by removing the tongue first by means of an intrabuccal operation, the glands being dissected out by a routine dissection in ten days time. Such a procedure may pass as satisfactory in early cases, or if it is the intention of the surgeon to perform a palliative operation. In most cases, however it must be regarded as incomplete.

If the operation must be performed in two stages, especially in advanced cases, it would seem better to dissect the triangles of the neck, ligating the external carotid on one or both sides, and then in a week or so to remove the tongue very freely by some intrabuccal method.

There is still another detail for consideration, and that is whether the glands should be removed from both sides of the neck. As before stated, the tendency in modern surgery is to progress to more radical methods but at the same time these methods should be checked by pathological and clinical observations.

It will be seen from the description of the lymphatics of the tongue (p 178) that certain vessels near the middle line communicate with the glands on both sides The same occurs in the case of the lymph vessels at the tip In cancers situated near the middle line or tip of the tongue *both* triangles, therefore, should be attacked.

Cancer of the posterior third of the tongue also leads to rapid bilateral glandular infection, and in these cases the glands must be removed from both sides as a routine

Out of 27 cases of lingual cancer carefully examined post mortem by Dr Kettle, pathologist to the Cancer Hospital, the glands were affected on both sides of the neck in 11 Out of 6 cases of cancer in the floor of the mouth, both sides of the neck were attacked in 5. Obviously therefore in cancer situated in the floor of the mouth—that



Fig. 1.—Section of tongue showing cancerous growth invading the genio-hyo-glossus.

Fig. 2.—Section of tongue showing cancerous growth invading the hyo-glossus.

PLATE 88.

hesitation in recommending it as we must no longer consider the question of deformity but endeavour to remove the disease completely By such an operation as this, with subsequent dissection of the glands, the requirements of the early case are met.

Position of the patient.—This must depend upon whether a preliminary laryngotomy has been performed or not. If this has been done and the back of the pharynx has been firmly plugged the position of the patient is only of importance to the operator the head may be raised or turned on the side whichever appears the more convenient

When no laryngotomy has been done, even if the large vessels have been tied, there is always a risk of blood trickling down the larynx into the lungs and favouring the development, later of septic pneumonia There are two positions in which the patient may be placed which will tend to prevent this —

i *Rose's position.*—A sandbag is placed under the shoulders and the head is allowed to hang back over the end of the table so that the mouth and throat are on a lower level than the trachea in this position little blood, even when the bleeding is free can pass into the lungs. Unfortunately the position causes great congestion of the veins and venous bleeding

ii. *The lateral position.*—The patient lies on his side with the head unsupported by a pillow and turned forwards and downwards towards the surgeon in this position the blood tends to run out of the angle of the mouth. Special gags which do not interfere with this position will be required.

Gags.—The surgeon will with advantage take some care in the selection of his gags for these cases. Nothing is more annoying, even dangerous occasionally than the slipping of the gag or the inability to expose the parts thoroughly Butlin recommends Coleman's gag [Gib]bson, Hewitt's modification of Mason's gag. Lane's or Wingrave's [us]eful instrument when the head is turned on the side, as there [are no] handles to get in the way A pair of large lip and cheek [retractor]s should be at hand

[...]ly half the ton[gue] ... be ... l the gag is placed on
[...]te to that af[fected] ... nt a ... gag is often required
[A]lthough m... o ... been abandoned for
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There is a further important detail Cheatle's specimens show the presence of glands between the fibres of the hyo-glossus, and dissemination of cancer cells in the lymph spaces of the submucosa for a considerable distance away from the primary focus and such evidence proves the risk of partial operations in any but very early cases.

In cancer of the tip of the tongue the spread of the disease, as shown in the diagram of the lymphatics (Plate 66, facing p 178) is through the genio-hyoids, and *these muscles together with the fascia covering them, must be removed.*

It has been urged that in all cases the whole tongue should be excised but I am quite unable to agree with this suggestion. As has been shown the tendency of the growth is to spread along the muscles on the affected side indeed, *the septum appears to exercise a limiting influence.* Recurrence on the opposite side of the tongue is very rare, and the more extensive operation of complete removal should be reserved for those cases in which it is obvious that both sides are involved, or in which there is disease of the opposite half demanding removal

Trotter however holds that anatomical considerations have had too much influence in the designing of operations for carcinoma, and that more account should be taken of the pathological distribution of the disease every operation should be for the removal of a tumour and not of an organ or any anatomical part of an organ therefore a lingual carcinoma should be excised as the centre of a hemisphere of which all radii extend beyond the edge of the growth to a distance varying with the apparent malignancy of the growth, and such anatomical structures as the median raphe of the tongue should have no consideration.

Large ulcerating and infiltrating growths will require complete removal, and so will most of the growths situated in the posterior part,

THE OPERATIONS FOR LINGUAL CANCER

1 Whitehead's intrabuccal operation and its modifications.—This method consists in removing the whole or half of the tongue through the oral cavity any of the preliminary steps mentioned previously such as laryngotomy or ligation of the external carotid or lingual being performed according to the opinion of the operator

In cases where sufficient room cannot be obtained by the introduction of the gag, the cheek may be split back towards the masseter on the affected side. If it is desired to follow out the recommendations given above, and remove the muscular tissue down to the hyoid bone, this additional step will be found to give easy access. I have no

hesitation in recommending it, as we must no longer consider the question of deformity but endeavour to remove the disease completely. By such an operation as this, with subsequent dissection of the glands, the requirements of the early case are met.

Position of the patient.—This must depend upon whether a preliminary laryngotomy has been performed or not. If this has been done, and the back of the pharynx has been firmly plugged the position of the patient is only of importance to the operator, the head may be raised or turned on the side whichever appears the more convenient.

When no laryngotomy has been done, even if the large vessels have been tied, there is always a risk of blood trickling down the larynx into the lungs and favouring the development, later of septic pneumonia. There are two positions in which the patient may be placed which will tend to prevent this:—

i. *Rose's position.*—A sandbag is placed under the shoulders and the head is allowed to hang back over the end of the table so that the mouth and throat are on a lower level than the trachea. In this position little blood, even when the bleeding is free, can pass into the lungs. Unfortunately the position causes great congestion of the veins and venous bleeding.

ii. *The lateral position.*—The patient lies on his side with the head unsupported by a pillow and turned forwards and downwards towards the surgeon. In this position the blood tends to run out of the angle of the mouth. Special gags which do not interfere with this position will be required.

Gags.—The surgeon will with advantage take some care in the selection of his gags for these cases. Nothing is more annoying, even dangerous occasionally, than the slipping of the gag or the inability to expose the parts thoroughly. Butlin recommends Coleman's gag. Jacobson, Hewitt's modification of Mason's gag. Lane's or Wingrave's is a useful instrument when the head is turned on the side, as there are no handles to get in the way. A pair of large lip and cheek retractors should be at hand.

When only half the tongue is to be removed the gag is placed on the side opposite to that affected, but a second gag is often required.

Sponges.—Although marine sponges have been abandoned for modern surgical work in the abdomen, they have a distinct field of usefulness in operations on the mouth and throat, and are strongly recommended. It will be found, however, that the coarse Turkey sponge is much more serviceable than the finer sponges usually employed, as it absorbs blood better and does not get so slimy. One dozen small swabs to be used on holders and three or four larger ones, each firmly secured by a stout silk thread, should be in readiness.

These are wrung out of weak carbolic (1 100) and are placed in charge of a nurse, who rinses and returns them clean to the surgeon as he requires them.

The anæsthetic. — When anæsthesia has been induced, the administration may be continued either through the laryngotomy tube or the nose, as the case may be. Chloroform is the best anæsthetic. The laryngeal reflex should not be lost. Intratracheal anæsthesia may be substituted, but if a cautery or a diathermy knife is used, *chloroform must be employed and not ether* the chloroform may be given by means of a mask held over the mouth of the intratracheal tube.

Operation —The mouth being widely opened, two stout threads are passed through the tip of the tongue one on each side of the middle line. A further thread may with advantage be passed through the base of the organ, close to the epiglottis, of course wide of the disease. This step is especially advantageous when the whole tongue is to be removed and is usually required at the completion of the operation, to prevent the stump falling back and occluding the larynx as a preliminary measure it will facilitate the protrusion of the tongue and also the dragging of the bleeding-point into view in the event of hæmorrhage

The tongue is now pulled well forwards by means of the ligatures, and the surgeon cuts through the tongue along the middle line of the dorsum from base to tip by means of a knife (Fig 339) This incision is deepened by cutting, blunt dissection, or tearing, to the hyoid bone. The mucous membrane is then cut through with scissors around the affected half from the frænum anteriorly to the anterior pillar of the fauces posteriorly If necessary this latter structure is divided. As much mucous membrane as possible should be left, as it falls into position and covers the raw surfaces, but the first essential is to cut wide of the growth

If the disease is situated near the anterior part of the tongue, it is advisable to draw one or two incisors, so that the scissors can be dipped down behind the jaw close to the bone.

The affected half is now free internally and laterally so that by traction on the suture it can be dragged well out of the mouth. By a series of short scissor-cuts, beginning in front the deep attachments to the hyoid bone are severed this dissection should be very thorough, every effort being made to remove the muscular fibres right down to the hyoid. The half of the tongue will now be attached posteriorly only and contains the lingual arteries still intact. If these have not been secured previously they may be exposed before division, as follows A number of short snips are made through the posterior attachments of the organ, with separation of the muscular fibres

near the middle line the artery will start into view as a bluish cord and can then be secured with forceps or, better ligatured by means of an aneurysm needle before the final severance of the affected portion It is well worth while to spend a little time securing the vessel for the lingual tissue is extremely friable and as the tongue is brought forward under tension the forceps may be dragged off and troublesome bleeding may ensue if this does occur the fingers should be passed back beyond the epiglottis and the base of the tongue should be hooked forward, after the method recommended by Heath—a step which

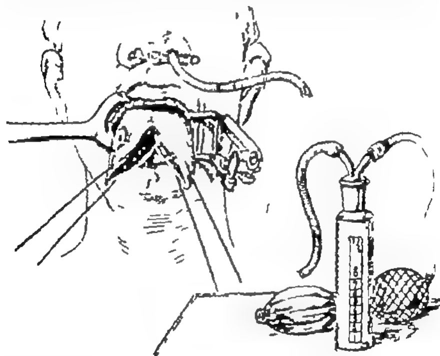


Fig. 239—Whitehead's operation (intrabuccal) for removal of half the tongue (*After Fowler*)

while it checks the bleeding temporarily enables the stump to be brought well into view

Cathcart (quoted by Jacobson) secures the artery in the following way After the ordinary steps have been taken and the tongue well freed, has been dragged out of the mouth "the anterior border of the hyo-glossus is defined by a few vertical strokes of the director this instrument is next insinuated beneath the muscle the tissues being separated with the point before it is pushed in The muscle is next carefully cut through on the director for about two-thirds of its extent (this incision should be close to the hyoid) and the fibres retracting leave the artery exposed at the bottom of the wound covered

only with a little connective tissue it can be under-run with a ligature carried by an aneurysm needle and leisurely tied." Whitehead relied mainly on twisting the artery but it is wiser to ligature it with silk or chromicized catgut.

If the whole tongue is to be removed it may be split, provided that the split does not pass through diseased tissue, and each half may be dealt with as recommended above or better each side may be freed without the median incision, and the arteries secured by the methods previously recommended. In any case, when the whole organ is excised a stout ligature should be left through the stump close to the epiglottis to enable the surgeon to pull it forward in case of hæmorrhage, and also to prevent the falling back of the stump and consequent obstruction to respiration

After the diseased tissues have been freely removed, any vessels which still bleed should be clamped, and tied if possible, but the friable tissue and the depth of the wound may make this procedure difficult. Any mucous membrane that is left should be used to cover over the raw surface, being fixed in position by catgut sutures if only half the tongue has been excised, the anterior part may be folded back and used to cover the raw surface near the median line. Such a step checks the oozing and accelerates the healing of the wound.

If, in spite of the above precautions bleeding still continues, gauze strips should be packed on to the raw surface.

Whitehead swabbed the wound over with a special varnish, made by substituting for the spirit used in Friar's balsam a saturated solution of iodoform in turpentine or ether Iodoform powder may be used instead. I recommend the use of antiseptics, especially of iodoform and carbolic for these cases.

The gag is removed, and the suture through the lingual base is fixed to the cheek by a piece of strapping.

The after treatment will be considered later.

2 **Kocher's submaxillary method.**—By this method, *which was introduced by Professor Kocher in 1880 an attempt* was made to remove the lymphatic glands, salivary glands and tongue in continuity without cutting across infected lymphatic spaces further, a preliminary tracheotomy was performed and the pharynx was kept plugged for some days until all danger of septic pneumonia was past. Although founded on a sound scientific basis, the method has not been very successful, and Kocher himself has abandoned it for the procedure usually described as Syme's operation (p 238)

Cheatle's modification.—Lenthal Cheatle has described to me an operation which is a modification of Kocher's method, and which is believed to be an advance on many of the operations practised.

No preliminary tracheotomy or laryngotomy is done. A free incision is made from the mastoid process to the symphysis menti curving down below the hyoid and a vertical or oblique incision is added below (Fig 310) The dissection is then carried out from below upwards, all glands, fat, and fascia being dissected away from the main vessels. The facial and lingual arteries are tied near their origin. The interval between the posterior belly of the digastric and the mylo-hyoid is now sought for and these muscles are retracted, the former backwards and downwards, and the latter forwards, its

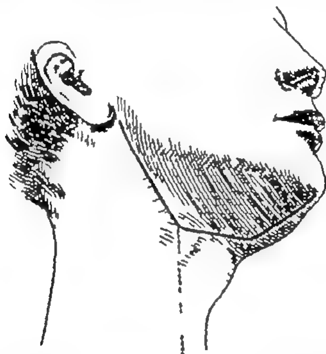


Fig 340.—Lines of incision for modified Kocher's operation.

fibres being divided if necessary The base of the tongue at its attachment to the hyoid is exposed and the hyo-glossus is divided along its whole hyoid attachment close to the bone continuing anteriorly the genio-hyo-glossus is cut close to the jaw—a difficult step—and the median interval between the muscles is sought for The genio-hyoid fibres of the genio-hyo-glossus are very rarely invaded and may be left. If only one half is to be removed, the mouth is now gagged open as in Whitehead's method and the remaining attachments of the organ are divided as in that operation, the posterior division going back to the styloid process. Turning again to the neck, it will now be possible to remove the tongue and the other structures freed

by dissection in continuity the separation being effected by a few touches of the knife The wound is left widely open.

If the whole organ is to be removed, similar steps are taken on the opposite sides to free the deep attachments and to secure the main vessels the oral mucous membrane is divided by the intrabuccal method, and the whole mass is extracted from the side first attacked.

The great dangers of the operation apart from septic pneumonia, are sloughing, cellulitis, and secondary hæmorrhage but covering the wound surface with sterile vaselin, as suggested by Upcott of Hull for operations on the tonsil, might possibly be of service in preventing cellular infection. I have been very pleasantly surprised to find how kindly these neck wounds heal, but I spend seven or eight days in preliminary cleaning of the mouth

3 **Syme's operation.**—This operation is practically identical with the later operation of Professor Kocher It consists essentially in dividing the soft tissues in the middle line from the lip to the hyoid bone, and sawing through the mandible so as to gain access to the mouth and hyoid regions. Kocher operates with the patient in the Trendelenburg position but the operation can be efficiently performed with the head and shoulders raised and held forwards as in operations upon the tonsils and throat, or with the head turned laterally

If it be desired, lateral incisions may be carried outwards from the lower termination of the vertical incisions, and flaps can be dissected up thus enabling the operator to remove the salivary and lymph-glands of the submaxillary triangle at the same time.

The actual operation is performed as follows The anæsthetic having been administered (a preliminary laryngotomy or tracheotomy is not required) the surgeon divides the soft parts of the chin as far down as the hyoid bone. The vessels being secured, the jaw is drilled without previous separation of the periosteum, below the teeth a quarter of an inch on either side of the middle line, and is then sawn through. The two halves are forcibly retracted, the tongue is well drawn out by a loop of strong silk, the mucous membrane snipped through between the tongue and the alveolar process, and the anterior pillars of the fauces are divided. The genio-hyo-glossi and genio-hyoids (one side only if only half the tongue is to be removed) are now cut through and the tissues of the floor of the mouth separated as deeply as necessary with scissors or bistoury aided by the finger any vessels that require it being tied with silk. The tongue being thus freed laterally and below as far back as is needful, the transverse section is made one half at a time, the lingual arteries being secured as recommended above.

Bleeding is checked, the wound is treated by Whitehead's method,

and the two halves of the jaw are united by wire the skin incision is sewn up but a large drain is inserted into its lower end above the hyoid bone.

There is no doubt that this operation gives an easy access to the diseased organ, and it is especially valuable when the growth extends far back. At the same time it is open to the objections that the lymphatic glands are not thoroughly removed that there is some risk of cancer contamination of the wound and that the jaw is liable to necrose near the saw-cut. In cases where the disease lies anteriorly and extends to the bone the surgeon can by a simple modification remove growth and bone in continuity

Regnoli's operation which consists in an exposure of the tongue by a transverse incision below the jaw with transverse division of the muscles attached to the hyoid, is rarely practised. It is most suitable in cases where the disease attacks the anterior part of the tongue and floor of the mouth.

Carless, quoted by Jacobson, recommends transhyoid pharyngotomy when the disease is far back, the anterior part of the tongue being saved.

When the growth affects the posterior part of the tongue or spreads back to the palate and tonsil a favourable result can be obtained but rarely and very complicated and dangerous procedures, such as Langenbeck's method of slitting the cheek and dividing the jaw will be required if complete extirpation is to be attempted. The results of those operations rarely justify their performance and it must be admitted that cancer of the tongue far back is most unfavourable for surgical treatment.

When the jaw is involved anteriorly the outlook, though less hopeless, is distinctly unfavourable. An attempt should be made to remove the growth and the affected bone by some of the methods mentioned above and it is often possible to leave a bridge of healthy bone from the lower border of the horizontal ramus, with the effect of contributing to the patient's comfort.

Whatever operation is performed it is always advisable to pass a suture through the stump of the tongue, and to bring the suture out of the mouth and fasten it to the cheek or ear

After-treatment in operations for lingual cancer.—For the first twenty four hours, or longer in severe cases, the patient must be kept lying on the side or even on the face, with the head low so that the discharges can trickle out of the mouth on to a pad of gauze or wool A special nurse should always be in attendance, and should watch for bleeding (usually venous oozing) and for obstruction to respiration. Bleeding as a complication will be considered later

If the breathing becomes obstructed, the stump of the tongue should be pulled forwards by means of the attached string and if that fails, a finger should be passed to the base of the tongue, the pharynx cleaned, and the stump hooked forwards. These manœuvres usually succeed. Morphia ¼–½ gr. should be given, and the patient should be fed by nutrient enemata and disturbed as little as possible.

If the weather is cold, screens or curtains should be placed round the bed, and a bronchitis kettle charged with some antiseptic, such as tinct. benz. co or guaiacol carbonate, should be used to keep the air warm and moist This is not intended to imply that every patient is to be kept in an atmosphere saturated with steam, but to suggest that there are very definite uses still for the steam-kettle. If the steaming is overdone there is a greater risk of pneumonia Should the patient show signs of collapse after the operation, enemata of hot saline (103 F.) with strong coffee and brandy should be given

During the first twenty four hours the patient should not be disturbed the mouth may be swabbed out occasionally with some weak permanganate of potash if there is any tendency to the collection of clots and mucus but on the whole the quieter he is left the better for frequent and unnecessary manipulations are decidedly harmful.

Small pieces of ice may be given to him if the mouth is dry and thirst is intense

At the end of the twenty four hours any gauze plugging that has been introduced should be removed, and the routine treatment of the mouth undertaken. This consists in frequent irrigations and swabbings with weak antiseptics, preferably weak carbolic or permanganate of potash, alternated with a solution of bicarbonate of soda to get rid of the clinging mucus. A large irrigator fixed to the wall near the head of the bed, and fitted with a glass vaginal douche nozzle controlled by a tap or clip allows the nurse, and afterwards the patient, to wash out the oral cavity very thoroughly of course, provision must be made for free exit of the fluid

The patient should be propped up in the sitting position for dressing and inspection of the mouth, which should be done in a good light, and in the less severe cases he may remain sitting up after the first twenty four hours in the more severe the recumbent posture must be maintained for two or more days.

Dawbarn insists on the need for keeping these patients in the Trendelenburg position until they are able to swallow so preventing them from inhaling septic matter from the wound. This position is very uncomfortable for the patient, and if the wound can be kept decently clean is unnecessary but if the wound is foul, owing to the loss of control of the epiglottis there is a real danger of septic

particles finding their way down the larynx and trachea, and the position must be maintained.

Every two hours during the day and every four during the night the nurse on duty should gently wipe away blood and débris with a small, soft sponge moistened in antiseptic. The patient should be encouraged to irrigate his own mouth every hour during the day. Adherent blood-clot can be removed with forceps, but when sloughs appear the greatest care should be exercised in detaching them as their removal may be followed by hæmorrhage. If the case goes well the patient should be got up in a chair on the third day. It will often be advisable to keep the patient recumbent for a longer period, and to delay a little his getting up if old and enfeebled, but the special points to attend to are frequent irrigations and the preservation of local cleanliness as far as it is possible to obtain it.

Feeding.—For the first twenty-four or forty-eight hours food should be given rectally; after that, in many cases the patient is able to swallow and the food is given by a feeder to the spout of which is attached a rubber tube that can be passed well to the back of the throat. It is well to make a trial with some water first, in case the food should regurgitate and soil the wound.

All food given should be carefully sterilized until healthy granulations have covered the raw surface.

In the more severe cases the patient must be fed through nasal or œsophageal tubes until the power of swallowing is regained. Great care should be exercised in the feeding and absolute cleanliness is essential.

Complications.—Hæmorrhage may occur shortly after the patient has been returned to bed and is commoner after the more severe operations. It may be due to the slipping of a ligature or to the opening up of veins which had ceased to bleed during the operation. Such a complication must be carefully watched for, since a sudden hæmorrhage of this kind may choke the patient, or by trickling down the trachea favour the development of septic pneumonia. If the bleeding is free the mouth should be widely opened, clots swabbed out with a sponge, and a strip of gauze packed on to the bleeding area. If thought advisable, forceps may be applied and the vessel ligated.

True secondary hæmorrhage is rare in spite of the often septic state of the wound; even when extensive operations are done upon the neck, which is thrown into communication with the mouth, it is rare for the ligated vessels to bleed. The precaution should always be taken in these cases, to tie the vessels a little distance—from half an inch to an inch—away from the main trunk. If the external carotid is tied, it should not be secured too close to the common vessel.

Should this secondary bleeding occur it is usually encountered when the sloughs separate, is rarely serious, and readily yields to treatment. The mouth should be opened widely washed out and swabbed if the bleeding point can be seen, it should be caught with forceps and a ligature applied. Failing this, it is often sufficient to pack a strip of gauze firmly down towards the bleeding-spot and get the patient to close his mouth upon it. As a temporary even as a permanent, measure this is wonderfully efficient in the only case of secondary hæmorrhage under my care this method of treatment was followed by the complete arrest of the bleeding

Sloughing and cellulitis.—After extensive operations, especially where the mouth has been unusually septic beforehand cellulitis may occur It should be treated by free incisions and carbolic fomentations. As a preventive measure, few sutures should be employed in the large neck wounds, as they favour the retention of discharges. Frequent irrigations are the surest way of dealing with these infected wounds. I have no experience of antistreptococcic serum, but recommend the preparation and use of a vaccine

This complication, following on a long and exhausting operation, is a very serious one, likely to lead to a fatal issue.

Septic pneumonia is responsible for the fatal termination of a large number of cases. More can be done to prevent it than to treat it when it has supervened. Local cleanliness, avoidance of hæmorrhage, and the adoption of a position of the patient favouring the free removal of discharges are to be strongly advocated. In very septic states, inhalations of guaiacol carbonate are of distinct value.

When signs of pneumonia have developed, every effort should be made to support the patient's strength with nourishing food and stimulants. A localised abscess or gangrene of the lung will probably require treatment, should the patient survive.

Removal of the glands.—If the intrabuccal method of Whitehead is selected, whether the glands appear enlarged or not, a complete dissection should be made of the anterior triangle of the neck within ten days of the removal of the tongue. The indications for attacking both sides have been given already

Butlin's method (Fig 341)—The best method for removing the glands in early cases is that described by Butlin. Three flaps of skin with very little subcutaneous fat, are dissected back, and then working from below upwards, everything is cleaned away in one sheet except the muscles and the large vessels. The submaxillary gland and the lower portion of the parotid gland should be removed deliberately This point is especially important, as there are a number of lymphatic glands situated among the

glandular alveoli in both instances. The wound should be freely drained Healing is, as a rule by first intention and the results are excellent some saliva may escape from the posterior angle of the wound but this soon ceases to run I use two drains. The operator should bear in mind that the lymph vessels from the tip of the tongue pass directly to the glands of the internal jugular vein

Maitland's operation is somewhat more radical, and is suited to more advanced cases. The skin incisions are similar except that

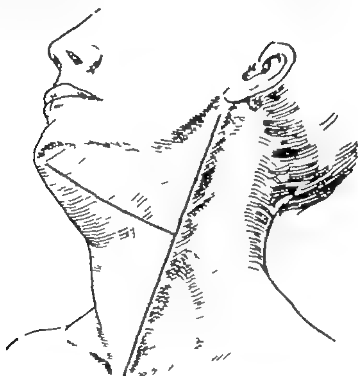


Fig 341 —Incisions for Butlin's gland dissection.

the lower vertical incision is carried back along the clavicle Maitland is careful not to leave the subcutaneous fat behind in the submental and submaxillary regions, as the glands here are very superficial. He begins his dissection posteriorly and above after reflection of his flaps, and insists on the removal of the lower part of the parotid and the whole of the submaxillary gland. Next he dissects the anterior triangle from below dividing the sterno-mastoid, and then working upwards he approaches the region already attacked, finally severing the sterno-mastoid at its upper attachment If necessary he removes the internal jugular vein subsequently he does not recommend secur

ing it before, as the veins become congested, and there is then a great deal of venous oozing. This is a very radical operation, and is efficient; it affords easy access to the upper deep cervical glands, which can only be reached with difficulty when the sterno-mastoid is preserved, and it is not open to the same objection as Crile's dissection, which entails temporary compression of the common carotid.

Block dissection, as practised by Crile, should be reserved for the most advanced cases. It is an operation of the greatest magnitude, and consists in removing the glands, the sterno-mastoid, and the internal jugular vein in one solid mass from below upwards. A clamp is placed on the common carotid artery. The main skin incisions are similar to those employed by Butlin.

Cases so advanced as to require these extremely radical measures are regarded by most surgeons as inoperable.

General conclusions with regard to operations for lingual cancer.—1. For very early cases the removal of the tongue by Whitehead's method and dissection of the glands in ten days' time may be adequate.

2. For more advanced cases, with definite enlargement of the glands, Cheatle's modification of Kocher's operation is to be preferred. On the whole, I recommend this as the routine operation for all cases that permit of its being done.

3. If in these advanced cases a two-stage operation is decided upon, the glands should be attacked first, the external carotid or its branches should be tied, and the tongue should be excised later.

4. In all advanced cases, and in those specially mentioned above, the glands on the side opposite to the disease should be removed subsequently.

Diathermy.—Further experience in regard to the operative treatment of cancer of the tongue has crystallized my opinion along the following lines. In the ordinary case, as it presents itself to the surgeon, usually with a fairly advanced degree of ulceration and involvement of the glands, the operative results by cutting *only* leave much to be desired. I have therefore, in the last few years, applied the method of diathermy which was advocated first by Douglas Harmer of St. Bartholomew's, and have come to the conclusion that it denotes a distinct advance as far as the operative results are concerned. Diathermy, which consists practically in cooking the affected portion of the tongue by means of a powerful electric current, enables a much larger area of tongue to be removed, with a greater chance of destroying any cancer cells that might possibly lead to wound infection. It has this further advantage: it can be

applied to growths which are not accessible to ordinary surgical measures, such as growths in the posterior part of the tongue and the tonsillar region where their extirpation by means of the knife would involve the patient in a very serious, and usually hopeless, surgical procedure. By means of the diathermic cautery knife the growth can be circumscribed and destroyed and it is surprising how well the wound heals after the slough has separated It must be clearly understood that the application of diathermy implies the formation of a slough that is to say it involves, of necessity the production of a septic wound in the mouth. The extent of slough varies according to the exposure of the parts to the electric current. Further where any big vessel runs through the region to which the cautery is applied, this vessel must be tied as a preliminary measure otherwise it is apt to give way during the separation of the slough, with the result that secondary hæmorrhage ensues. The procedure, therefore, that I adopt now in most cases of epithelioma of the tongue is, that by a wide dissection I remove the glands that are involved, following in the main the principles laid down by Butlin. But I do not hesitate to sacrifice the sterno-mastoid or the internal jugular vein if I have any doubts as to my ability otherwise to make a complete clearance of the infected areas. I have found very little disability result from the sacrifice of the sterno-mastoid muscle In the course of the operation the lingual the facial, and usually the external carotid arteries are tied. The wound is drained and closed. I do not, on this occasion, always deal with the primary focus in the tongue, because I have found, as I have already pointed out, that the occurrence of the inevitable sepsis in the mouth caused by sloughing of the diathermy wound is apt to lead to secondary infection of the wound in the neck. And although no serious results have arisen in the way of secondary hæmorrhage or cellulitis, I believe that it is wiser if the dissection has been very extensive, to avoid this extra risk, and at the end of a week to destroy the tongue thoroughly by means of the diathermic cautery when the lymphatic spaces which pass from the tongue to the neck are occluded. In cases where the whole breadth of the tongue has to be sacrificed I tie the lingual artery on the opposite side at the same time that I dissect out the glands and then again in a week's time destroy the tongue.

It is early yet to judge of the success of this application of diathermy but my own opinion is that if it becomes necessary to practise any destructive operation, this method is more likely to be effective than mere section by scissors or knife. Further in cases which are distinctly inoperable in the sense that complete extirpation of the growth is out of the question, there is no doubt that considerable relief is

afforded to the patient by the destruction effected with diathermy. In many cases the primary growth can be destroyed, and the resulting ulcer will heal, thus removing one of the serious discomforts of the condition, namely, the constant pain and irritation to the ulcer caused by the food. And there is a further advantage, namely that the patient feels that something is being done for him. In many cases, owing to the extent of the growth, the surgeon realizes that a cure is out of the question, and that any interference of a limited nature with the knife or scissors will only result in a rapid spread of the disease. But by the use of diathermy which is, after all, a modified form of cautery, the rate of growth may be checked, or even the growth actually destroyed, and instead of the patient being dismissed with the depressing statement that nothing active can be done to relieve his suffering, active treatment is adopted which, if it fails to eradicate the disease in the widespread areas, at least allays the pain, and comforts him both mentally and physically.

Radium treatment.—So far I have dealt with the operative treatment from the established point of view, but by many who have studied this affliction, and have seen the results of different kinds of treatment, the conclusion must have been inevitably arrived at that the results of operative treatment, even in favourable circumstances, are extraordinarily bad. It is, therefore, with every feeling of justification that I mention the work of Douglas Quick of New York. He maintains that the surgical treatment of cancer of the tongue is useless, that the glands involved are concerned in a conservative process and represent one of Nature's barriers to the disease. He argues that the routine block dissection, as commonly practised, does not remove all the possible avenues of dissemination; it does, indeed, remove a barrier at a time when, perhaps, it is most needed to withstand the spread of infection. His plan consists in embedding radium in the substance of the primary growth, occasionally dissecting out the infected glands of the neck, and burying doses of radium emanation in several areas, and when the infected glands have invaded surrounding structures, radium emanation is buried uniformly through the mass, and no attempt is made to extirpate it. Quick is also a great advocate of the performance of the neck dissection under local anaesthesia. My own results, and those of many surgeons with whom I have discussed the operative treatment of lingual cancer, are so unsatisfactory that it is only right that any treatment, even though departing from the established lines so radically as does the method advocated by Quick, should receive consideration. I have no experience myself of the treatment of cancer of the tongue by means of radium, but I shall certainly try this method when I can obtain suitable apparatus.

SELECTED BIBLIOGRAPHY

Burton, *Lancet*, 1897 i. 241.
Butlin, *Diseases of the Tongue*. 1900.
Cooper Bramby *Guy's Hosp. Repts.*, 1837 ii. 404.
Da Costa, Keen's *Surgery* iii. 606–9.
Dawbarn, *Treatment of Certain Malignant Growths by Excision of the External Carotids*. 1903.
Ducrot, Thèse de Paris, No. 333, 1870.
Duplay and Reclus, *Traité de Chir.*, 1898, v 144.
Eve, *Proc. Roy. Soc. Med.*, 1910.
Fairbairn, *Med. Times*, 1845, xii. 302.
Fayrer *Clin. Surg. in India*, p. 485. 1866.
Fournier "Leçons sur les Syphilides tertiares de la Langue," École de Médecine Paris, 1877.
Goadby K. W., "Treatment of Pyorrhœa Alveolaris by Vaccines," *Brit. Journ Dent. Sci.*, London, 1903, xlviii. 602, 903
Helbing, *Jahrbuch für Kinderheilkunde* 1896, xl. 442.
Hennig, *ibid.*, 1877 xxi. 290.
Jacobson and Rowlands, *Operative Surgery*, i. 588. 1907
Johnston, *Laryngoscope*, St. Louis, 1909, xviii. 286–92.
Keith, A., *Human Embryology and Morphology*, p. 42. 1904.
Lepic, *Bull. de l'Acad. Roy. de Chir.*, Paris, 1857 iii. 16.
Levy R., "Tuberculosis of the Mouth," *Amer Laryngol., Rhinol., and Otol. Soc.*, St. Louis, 1907 pp. 253–63.
Maitland, *Austral. Med. Gaz.*, Oct., 1906.
Meneau, "Leucoplasie linguale étendue traitée par la Décortication," *Bull. de la Soc. Franç. de Derm. et de Syph.*, 1908, xix. 63.
Morrison, R., "The Diagnosis of some of the Common Ulcers of the Mouth, *Brit. Dent. Journ.*, 1907 xxviii. 1311 14.
Parrot, *Progrès Méd.*, Paris, 1881, p. 191
Piersol, *Human Anatomy*, p. 934.
Poncet, Thèse de Paris, No. 220 1873.
Quick, D., "Treatment of Carcinoma of the Tongue," *Ann Surg.*, 1921 lxxiii. 710.
Reboul, Assoc. Franç. pour l'Avancement des Sciences, *Gaz. Hebd. de Méd. et de Chir.*, 1897 p. 786.
Sabrazès et Bousquet, *Presse Méd.*, 1897 p. 209.
Stone, W G., "Lymphangioma of the Tongue," *Trans. Clin. Soc.*, 1907 xl. 280.
Tanturri, *Giorn. Ital. delle Mal. Vener e della Pelle*, 1872, [illegible]
Trotter W., "Hunterian Lectures on the Operative Treatment of Malignant Diseases of the Mouth and Pharynx," *Lancet*, April 19 and 26, 1913; "Prognosis in Carcinoma of the Tongue, *ibid.*, Oct. 24, 1914.
Upcott, "Operations on the Tonsil," *Lancet*.
Vanlair *Rev. Mens. de Méd. et de Chir* Paris, 1880, p. 54.
Warren, J. C., "Cancer of the Mouth and Tongue," *Amer Surg.*, Philadelphia 1906, xlviii. 481–514.
Wharton, *Med. News* Philadelphia, 1895, lxvi. 406.

THE SALIVARY GLANDS AND FLOOR OF THE MOUTH

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INJURIES OF THE SALIVARY GLANDS

THE PAROTID GLAND

Any of the salivary glands may be involved in an injury but it is the parotid which is most frequently damaged in this way on account of its comparatively exposed situation. The injury may be inflicted wilfully as by stabbing or gunshot wounds, or accidentally as during the course of a surgical operation. Armstrong of Montreal has recorded a case in which he accidentally injured the submaxillary gland while attempting to enucleate an overlying tuberculous gland. A fistula resulted which only closed after two further operations, the fistulous track being excised and the edges approximated by deep sutures. Injuries involving the submaxillary or sublingual gland are of far less serious import than those in which the parotid is concerned because if a permanent fistula results the gland can be excised completely with comparative ease and slight resulting disfigurement. The parotid gland however is so intimately connected with important structures that such a proceeding in relation to it is rarely justifiable unless the surgeon is dealing with a malignant new growth whose presence will inevitably cause the death of the patient.

Injuries to the parotid may be subdivided according to whether the gland substance itself is injured, or its duct only

Injuries of the Parotid-Gland Substance

The tissue of the parotid gland is frequently incised during the course of surgical operations in the neck, but primary union nearly always follows if the wound is closed with deep stitches, and a salivary fistula from this cause is uncommon.

Treatment.—In dealing with an external wound of the parotid gland substance the first duty of the surgeon is to exclude the presence

of injury to the important structures which traverse the gland particularly the facial nerve. The trunk of the transverse facial artery or some of its branches may be severed, so that there is likely to be severe hæmorrhage. This must, of course, be arrested and the wound sewn up. The important point to observe is that the sutures must pass down into the depths of the wound so that all the divided tissue is included otherwise, pockets may form which will prevent healing If the edges are jagged the contused portions must be cut away A firm bandage should then be applied The patient should be kept on a simple diet which does not demand mastication, and talking should be forbidden until the wound is healed.

Injuries of the Parotid Duct (Stenson's Duct)

Stenson's duct is liable to injury in vertical wounds of the face which cross its course at right angles. The wound may or may not perforate the cheek and form an opening into the mouth. The prognosis is better in the former case since if primary union of the divided ends does not occur (and, in spite of the statements of König, it rarely does occur) there is a possibility that the resulting fistula may become an internal one and a spontaneous cure be thus effected.

When the wound has been cleaned and the hæmorrhage arrested the divided ends of the duct will be seen protruding from the cut surfaces. The circumference of the duct is so small that partial division of it is rare

Treatment.—König believes that many such injuries have remained unrecognised, and that primary union of the duct has occurred spontaneously He maintains, therefore that it is the duty of the surgeon to unite the divided ends with fine catgut sutures, and close the external wound. If any wound is present in the mucous membrane it should be left open. He lays stress on the importance of the after-treatment described in connexion with wounds of the parotid gland itself (see above) This operation is one of extreme difficulty in view of the diminutive circumference of the duct, and, in my opinion, primary union rarely if ever occurs. Moreover if it fails, an external fistula is bound to ensue if the original wound was a non penetrating one. A better chance of obtaining a successful result is ensured by converting a non penetrating wound into a penetrating one by incising the mucous membrane. The external wound is then accurately closed. In the case of a wound which originally penetrated the mouth, closure of the external wound is all that is necessary In a certain proportion of cases the external wound remains closed and an internal fistula is formed, which, as far as functional activity is concerned, will answer all the purposes of the normal orifice of the duct

SALIVARY FISTULÆ

A salivary fistula is an abnormal communication leading from the gland or some part of its duct to the interior of the buccal cavity or to the skin surface externally

Internal fistulæ may be traumatic in origin but are occasionally congenital. An example of the latter was described by Bochdalek, in which the abnormal opening into Wharton's duct was situated eleven lines behind the sublingual caruncle. The condition is of no surgical interest, however inasmuch as it causes the patient no inconvenience.

The term salivary fistula, as commonly used, therefore, denotes the *external* variety where the secretion is discharged on to the surface of the skin.

Such a fistula may render the patient's existence miserable. The constant discharge of saliva, aggravated as it is at meal-times, may render him objectionable to his fellow men, so that he is compelled to satisfy his hunger in solitude. Further the orifice of the fistula is often surrounded by a patch of eczema from the constant irritation of the fluid dribbling over the cheek. It has also been said that the continual loss of salivary fluid may impair the health of the patient. This is hard to believe, though it is known that the amount excreted may assume large proportions, as is proved by two classical experiments. Duphenix collected from a salivary fistula 70 grm. of fluid in fifteen minutes, and a patient of Jobert's discharged "several cupfuls" in twenty four hours.

A persistent salivary fistula usually results from one of the injuries already described. It may have been originally neglected or inadequately treated or attempts to obtain primary union may have been made and have failed. The principal conditions which militate against primary union are *sepsis occurring in the original wound*, and severe contusion of its edges. In the case of an injury to Stenson's duct, primary union of the wound, even though its edges were clean cut and it remained aseptic throughout, must be regarded as the exception rather than the rule, and an obstinate fistula often results

Salivary fistulæ are also caused occasionally by ulcerative processes invading the tissues of the cheek, e.g. rodent ulcer, lupus, and actinomycosis.

Treatment.—For practical purposes salivary fistulæ may be divided into two main classes, the second of which is again divisible.

1 Gland fistulæ, communicating with the gland substance.

2. Duct fistulæ, communicating with the duct (i) as it lies over the masseter muscle (massoteric) (ii) as it lies in front of the anterior border of the masseter (buccal).

1 Gland fistulæ.—The treatment is usually rewarded with success, though patience is demanded on the part of the patient, and perseverance on that of the surgeon. Cauterization with a silver nitrate stick should first be given a prolonged trial. It should be done every alternate day and a fairly firm bandage applied. Küttner states that the actual cautery is more efficacious. If these measures fail after a reasonably long trial the whole fistulous track should be excised, and the edges brought together with deep sutures which include all the exposed tissue; in other words, after excision of the track, the resulting wound must be treated in the same way as a primary wound of the gland. Care must, of course, be taken not to cut any branches of the facial nerve during the operation.

2. Duct fistulæ.—The cure of a duct fistula is a much more tedious and difficult business. The variety of procedures which have been advocated from time to time and the ingenuity which has been expended in devising them, furnish evidence that there is no royal road to success.

The several methods which have been described come under two main headings—(*a*) those in which an attempt is made to restore the natural aqueduct, and (*b*) those in which an attempt is made to convert an external into an internal fistula. If their respective merits are regarded from an academic point of view there can be no doubt that the former is preferable, since it aims at restoring a natural state of affairs; but practically the chances of success by this method are so small that in my opinion the second is the method of choice for the treatment of duct fistulæ.

Armstrong of Montreal gives a clear account of the method of Nicoladoni, who is the chief exponent of the first method. He writes: Nicoladoni has successfully joined the ends of the divided duct after removing the scar tissue. When there is a considerable gap he incises the cheek, picks up the proximal end of the peripheral portion, and frees it from the buccinator up to the caruncle; then, by making a crescentic incision through the buccal mucosa in front of the caruncle, he is able to displace the duct orifice as much as 1·5 cm. towards the gland, and so approximate the ends of the divided duct that he can unite them through an external incision. It is obvious that this method is ideal if it can succeed. But, since it rarely does so even in a primary wound of the duct, how much less is the chance of its doing so in an old-standing injury when the ends have become widely separated and the peripheral portion of the duct has usually ceased to be permeable.

The simplest method of converting an external into an internal fistula is that described and employed by Deguise in France and Pearce Gould in this country. It consists in passing a strong suture (either

silk or silver wire) from the fistula through the buccal mucous membrane in two places, one 0·5 cm. behind the other (Fig. 342) The ends which now protrude in the mouth are tied very tightly The tissue enclosed necroses, and thus an internal opening is formed. The external fistula then closes of its own accord. But, to make assurance doubly sure, the edges of the fistula may be pared and united with one or two fishing-gut sutures. This method has obvious limitations. It cannot,

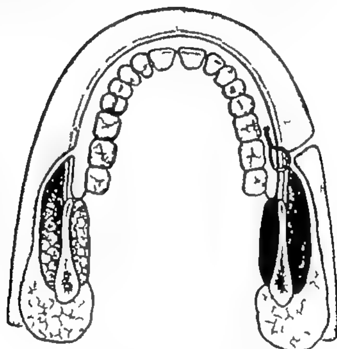


Fig 342.—Operation for fistula of salivary duct.

for instance, be used in a masseteric fistula, since it would be necessary to include the muscle in the ligature and this is not feasible.

Kaufmann has devised a modification of this method. The cheek is perforated opposite the fistula, and a small rubber tube 3 mm. thick is drawn through so that it projects both internally and externally At the end of a week it is cut down on both sides so that it is flush with skin and mucous membrane. In another week it is removed entirely He claims that the saliva will now flow into the mouth through the artificial orifice, and that the external fistula will close, especially if it is cauterized from time to time, or its edges are approximated by suture. The technique is extremely simple. One practical point must be observed the tube must fit tightly in the perforation in the mucous membrane, or it will not remain in position.

This method has one advantage over Deguise's. By making the

track of the tube oblique so that it enters the mouth in front of the masseter it is applicable to masseteric fistulæ whereas Deguise's method can only be applied to the buccal variety with any prospect of success.

None of the methods described of dealing with a salivary fistula can be regarded as infallible and if, after a patient trial, a cure is not effected, the question of arresting the salivary secretion altogether must be considered Two methods of doing this have been followed. Bramann has ligatured the duct on the proximal side of the fistula in three cases, and in two of them the result was satisfactory But he allows that a certain amount of risk is attached to it for instance the gland may become swollen from retention of its products and abscess-formation may develop secondarily The other alternative is to dissect out as much of the gland as possible taking care not to damage the facial nerve. This will necessarily lead to some disfigurement, but that is preferable to the distressing phenomena associated with a persistent salivary fistula

DISEASES OF THE SALIVARY GLANDS

INFLAMMATION

Etiology.—The etiology of sialo-adenitis is still a vexed question but it is now agreed that there are few if any inflammatory conditions of the salivary glands which are not primarily due to an ascending infection from the mouth along the duct

The etiology of sialo-adenitis as it is understood to-day may be compared with that of appendicitis. The appendix is normally inhabited by coliform bacilli. If stagnation occurs in it as the result of kinking, or the presence of a stercolith, the resistance of its walls to bacterial infection is diminished, and the bacillus at once becomes an invader and acute appendicitis is the direct outcome In the same way the mouth is normally inhabited by a number of different micro-organisms. As long as the salivary glands function adequately these organisms are prevented from invading by the flow of saliva and by the normal cell resistance but if there is any diminution of the salivary activity as occurs in pyrexia or after laparotomy (Pawlow has experimentally proved that this is a constant phenomenon in dogs) an ascending infection along the ducts immediately follows.

Ginner has tabulated the results of bacteriological examination in 53 cases of suppurative parotitis, as follows —

Staphylococcus aureus	28	Pneumobacillus	1
Staphylococcus albus	2	Micrococcus tetragenus	2
Pneumococcus	11	Bacillus typhosus	2
Streptococcus	5	Elongated bacillus (unclassified)	1

This table may be regarded as evidence in favour of the view that sialo-adenitis is nearly always, if not always, an ascending infection, since most of the micro-organisms mentioned, except the last, have been found in the apparently healthy oral cavity. In epidemic parotitis, however, the organism has not yet been definitely isolated, and it is therefore impossible to say whether it has entered by way of the duct or not. At the same time, the fact that there is generally a prodromal stage of stomatitis furnishes presumptive evidence in favour of the view that the disease is the result of an ascending infection. The secondary implication of the testis, which is so characteristic a feature of the disease, cannot be explained on such simple grounds, and must, on our present knowledge, be regarded as an infection by way of the blood-stream. We are therefore compelled to recognize two forms of acute sialo-adenitis.

1. Primary Acute Sialo-Adenitis

Epidemic parotitis, or mumps, is a highly infectious disorder, attacking adolescents. It is said that males are more commonly attacked than females.

The incubation period is long (sixteen to twenty-one days generally, but may be more, even up to six weeks). The onset is characterized by pyrexia, usually not higher than 101° F., and pain below the ear. In a day or two, one parotid gland begins to swell, and its outline becomes obvious. The skin over it is tense and œdematous. A day or two later the gland on the opposite side follows suit. The course of the disease is generally mild, but in severe cases the submaxillary salivary glands and the cervical lymphatic glands may be swollen. The temperature falls in a week, and the swelling then begins to diminish gradually. It usually disappears completely in a month, but some induration may remain for a longer period.

The **treatment** is simple. The patient should be kept in bed, and a cold compress applied to the swollen gland. Occasionally suppuration occurs in the parotid: an abscess must be incised as soon as its presence is diagnosed.

One of the most interesting features of the disease from a surgical point of view is inflammation of the testis, which sometimes occurs as a complication. The treatment of the orchitis is identical with that of the parotitis. Atrophy of the affected testis supervenes, according to Kocher, in one-third of the cases, even where spontaneous resolution has occurred; and if the orchitis has been bilateral sterility often results. Other glands may be similarly affected, such as the pancreas, the lachrymal glands, and, in the female, the ovary and mamma.

3. Secondary Acute Sialo-Adenitis

This differs from the primary form in running a more acute course in fact suppuration is the rule.

The predisposing conditions may be divided into three main classes —

i. *Abnormal conditions of the oral cavity* particularly all forms of stomatitis.

ii. *Acute diseases*, such as typhus variola, pneumonia, typhoid and pyæmia. Less acute disorders have also been known to cause it. In carcinoma it is not uncommon and in a case of Klippel's it was a complication of tabes. Carr has recorded an attack of acute gangrenous parotitis, as a terminal event, in a case of chronic nephritis associated with a granular condition of the kidneys.

iii. *Diseases of the abdominal viscera* —Attention was first directed to the association of acute parotitis with abdominal disease in cases in which ovariotomy had been performed. In view of the observation that epidemic parotitis was often followed by orchitis and oöphoritis, it was at first presumed that there was some sympathetic connexion between the two sets of organs, and that one responded reflexly to disease or injury of the other Stephen Paget collected 101 cases of parotitis following upon disease of the abdominal or pelvic viscera and of these " 50 were due to injury disease, or temporary derangement of the genital organs, a percentage which lent colour to the hypothesis. This view is not generally held now After laparotomy as in pyrexia, the mouth is dry and there is diminished salivary secretion, so that the glands are in a state which renders them particularly liable to infection Further investigation has shown that the abdominal cases which are most constantly followed by parotitis are those in which rectal feeding is necessary such as gastric ulcer In patients who are being rectally fed the mouth readily becomes septic, in spite of the most skilful care and attention, and the infection spreads up to the glands along the ducts.

Secondary acute inflammation is confined almost entirely to the parotid. When it occurs after laparotomy the swelling of the parotid begins about the end of the first week. In connexion with other diseases, no definite date can be stated. The lower pole of the parotid generally enlarges first but soon the swelling involves the whole gland, so that the side of the face is broadened and the ear is pushed out. The skin over the parotid is at first tense, but later becomes red and œdematous, with dilated veins running over the swelling Great pain is experienced, because the gland is covered by dense unyielding fascia, and the tension of the parts is considerable General malaise is complained of and the temperature, which is always raised, may even reach 105 F

so that French writers have given the name "*coliques salivaires*" to these attacks.

The tissues around the calculus become indurated as a result of chronic irritation, and suppuration may occur a circumstance which can be diagnosed by the periodic discharge of pus into the mouth. More rarely the stone ulcerates through the wall of the duct either into the mouth or in the case of a stone in Stenson's duct, externally giving rise to a salivary fistula.

Calculi may also be situated in the substance of one of the salivary glands. In this position they are nearly always small and multiple, and each calculus is surrounded by a small abscess. In such a case *the gland is chronically inflamed, enlarged, and tender* and there is a more or less constant escape of pus into the mouth.

The **diagnosis** is not a matter of difficulty in the absence of secondary septic changes. In most cases the calculus can easily be felt as a hard body through the mucous membrane on bimanual examination. But if acute inflammation has supervened, the true cause may easily be overlooked and the case treated as one of septic adenitis due to an ascending infection. To avoid this error an attempt should always be made to probe the affected duct. An X ray examination is of material assistance.

Treatment.—If the stone lies in the duct, this is easy All that is necessary is to slit up the mucous membrane and remove the calculus with forceps. Antiseptic mouth-washes should be prescribed. The symptoms will rapidly abate even in cases in which sepsis has supervened. Calculi in the gland are not so easily dealt with. If the affected gland is the submaxillary it is best to enucleate it entirely but in the case of the parotid this is not feasible. Here an incision must be made and the calculi extracted, care being taken of the facial nerve. A gland fistula may result this must be subsequently treated in the manner already described.

ACTINOMYCOSIS TUBERCULOSIS SYPHILIS, MIKULICZ'S DISEASE

The infective granulomata very rarely attack the salivary glands **Actinomycosis** has not been recorded as a primary infection, but *any of the salivary glands may become implicated* by a direct extension from the disease when it begins in the face or jaw

Tuberculosis is also exceedingly rare only about a dozen cases have been recorded in all. The main clinical interest lies in the difficulty of diagnosing the condition from subacute septic inflammation. Too much reliance should not be placed on the tuberculin reaction The only positive method of diagnosis is microscopical examination of a portion of the enlarged gland removed by operation.

The clinical history closely resembles that of tuberculosis of lymphatic glands, i.e. the enlargement is chronic, but a cold abscess is prone to occur Treatment consists in draining the abscess or in partial removal of the parotid or total excision of the submaxillary gland according to the pathological condition present, and its position.

Syphilis attacking the salivary glands is also rare the whole of medical literature affording only some twenty five cases. It is a late manifestation, although Neumann has reported five cases which occurred in the first year of the disease. The lesion usually takes the form of a gumma or of an interstitial fibrosis. It used to be said that the diagnosis was only possible in the presence of other syphilitic lesions, but in the absence of these it can be made in the majority of instances with the aid of the Wassermann reaction. No special treatment, other than general antisyphilitic remedies, is required.

Mikulicz's disease is a rare condition which has been described as a clinical entity by von Mikulicz of Breslau. It consists of a symmetrical enlargement of the salivary and lachrymal glands Other glands according to subsequent observers, may also be involved e.g the labial and buccal glands and the gland of Blandin and Nuhn

The enlargement begins in early adult life, without apparent cause and is steadily progressive the parotid may enlarge to the size of a man's fist. The swellings are firm or elastic to the touch, but do not fluctuate, nor are they tender Disfigurement and inconvenience due to the local enlargement are common but life is not endangered. Arsenic and potassium iodide have produced improvement in some cases, in others the disfigurement has been sufficient to call for extirpation of the affected glands. There is no tendency to recurrence.

The **pathology** of the condition is extremely obscure. Microscopically the glands show an infiltration of small round mononuclear cells. Mikulicz himself regards it as being "a new formation of lymphadenoid tissue which is spread round the acini as centres, and leads to the destruction of the specific gland tissue. Tietze's view is that it is an adenoid proliferation of the lachrymal and salivary glands." Other authorities lean to the view that it is a chronic infective process. In no case, however has any relation to syphilis or tubercle been d monstrated

CYSTS OF THE SALIVARY DUCTS AND GLANDS

Cysts of the Ducts

Retention cysts are known to occur in connexion with both salivary ducts and glands. Cysts in Stenson's or Wharton's duct may result from definite obstruction due to a calculus or to cicatricial fibrosis of the orifice but they are occasionally found when there is

It presents as a rounded bluish-grey translucent, fluctuating swelling, with vessels of the mucous membrane stretched over it, and contains a slimy, colourless material like the white of egg. It causes no symptoms other than the inconvenience due to the presence of an abnormal swelling in the mouth which may interfere with mastication and render articulation imperfect.

The **etiology** of a ranula is much disputed. According to von Hippel, it is a sublingual-gland cyst, starting in the smaller excretory ducts, entirely analogous to the salivary-gland cysts described in the preceding section (p. 260). Neumann regards it as an epithelial cyst derived from a tubule of one of Bochdalek's glands, while von Recklinghausen inclines to the view that it is a cystic dilatation of one of the ducts belonging to the gland of Blandin and Nuhn, the result of obstruction by a foreign body or by inflammatory thickening of its walls. J. E. Thompson on the other hand contends that it is a remnant of a part of the cervical sinus, displaced upwards at the time when the tongue muscles move forward in development, and not obliterated. He has shown that it is often associated with cysts in the neck and in the submaxillary region, and that sometimes a blind track can be traced from the ranula into the tongue towards the submaxillary region.

A sublingual dermoid cyst in the floor of the mouth may resemble a ranula very closely but it is usually adherent to the mandible or to the hyoid bone, and this is the only point on which reliance can be placed in making a differential diagnosis.

Treatment.—The only really efficient treatment is to dissect out the cyst entirely after incising the overlying mucous membrane. If this is *not possible the next best method is to cut* away *the whole* of the anterior wall and to allow the cavity so formed to cicatrise slowly.

Some authorities advise removing a ranula through a submental incision, especially if the cyst is a big one and projects downwards and forwards towards the mylo-hyoid. But there is little advantage in this. The exposure afforded is no better than that obtained by the intrabuccal method and from an æsthetic point of view a scar in the mylo-hyoid region should always be avoided if possible.

TUMOURS OF THE SALIVARY GLANDS

Tumours of the salivary glands may be classified as follows:—

A. Tumours of *epithelial origin*—

Innocent: Adenoma.
Malignant: Carcinoma (*a*) Adeno-carcinoma.
(*b*) Scirrhus.

B. Tumours of *connective-tissue origin*—

Innocent Angioma.
Fibroma.
Chondroma.
Lipoma.

Malignant: Sarcoma—

(*a*) Round-celled.
(*b*) Spindle-celled.
(*c*) Melanotic (Billroth and Kaufmann).

C. *Mixed or composite* tumours.

A. Tumours of Epithelial Origin

A pure **adenoma** of the salivary glands is so rare (Nasse has reported four cases) that it demands only passing mention. It grows slowly and on section closely resembles the normal structure of the gland. It is possible that several of the cases described as hypertrophy of the parotid were in reality adenomas.

Carcinoma is also very uncommon, but sometimes attacks the salivary glands, usually the parotid. It may take the form of a spheroidal-celled carcinoma (scirrhus variety), but is more commonly an adeno-carcinoma. The latter may occur at any age, but generally first makes its appearance in early adult life as a firm elastic swelling. It then grows fairly rapidly and if left untreated may involve the overlying skin, which then becomes ulcerated. Facial paralysis is usual, varying in degree according to whether the main trunk of the nerve or some of its branches are involved. The scirrhus type occurs later in life, grows rather more slowly and forms a densely hard tumour immovably fixed to the skin and surrounding tissues. Metastatic deposits are found in the lymphatic glands in both varieties. The sublingual gland may also be the seat of carcinoma. In fact, some authorities believe that all carcinomas of the floor of the mouth are derived from this source. The prognosis with regard to life is bad in either case, but worse in the adeno-carcinomatous form. The diagnosis can only be made with certainty by removing a portion of the growth and subjecting it to microscopical examination.

As soon as the diagnosis is certain, no time should be lost in enucleating the affected gland completely if this is still feasible. It can rarely be done if the surface is already ulcerated. In this case the outlook is very bad indeed but improvement is sometimes produced by the application of X rays or of radium, or by zinc ionization

B Tumours of Connective Tissue Origin

Innocent tumours of this class are theoretically possible, but are practically almost unknown Pathologically their characteristics do not differ from those presented when they occur in other parts of

the body An accurate diagnosis is rarely arrived at before the tumour is removed and examined histologically

Sarcoma.—Various forms of sarcoma have been described, but they are comparatively rare. Some of them are pure sarcomas of the round or the spindle-celled variety They form rapidly growing ill-defined tumours which are difficult to distinguish from subacute inflammation. Fibro-sarcomas are more often encapsulated and present as localized swellings, which can be enucleated in their capsule from their surroundings. It is said that if this is done completely they do not tend to recur I am sceptical of the truth of this statement.

Melanotic sarcoma of the parotid has also been described by Kaufmann and Billroth the tumour being characterised by excessive pigment formation.

Other sarcomas of the salivary glands, especially of the parotid, are really examples of "mixed tumours, one of whose elements has become malignant and has taken on a sarcomatous growth. Such are sometimes described as chondro-sarcoma, myxo-sarcoma, etc.

When the presence of sarcoma has been diagnosed the affected gland should be removed in its entirety A fibro-sarcoma may however be shelled out with its capsule, as has already been said. It should be noted that the true sarcomatous nature of these tumours has been called in question. Coley has reported the cure of a small round-celled sarcoma of the parotid by the injection of his fluid (*Ann Surg., Philadelphia* 1903)

C. Mixed Tumours

This class of tumour of which specimens are shown in Figs. 343 and 344 is the most important from the clinical point of view since it is the commonest neoplastic affection of the salivary glands. It is also one of the most interesting from a pathological standpoint, in view of the difficulty of tracing its origin or of determining to what class of tumours it belongs.

A mixed tumour forms a localised well-defined outgrowth from the gland. The direction of its greatest prominence will depend upon the portion of the gland from which it takes origin. In the parotid this is usually the anterior inferior angle and the growth tends to extend down into the neck. Occasionally the growth starts on the deep aspect, and it will then extend inwards towards the pharyngeal wall. In the submaxillary gland it usually springs from its superficial surface and forms a swelling in the submental region. The sublingual gland is rarely if ever attacked.

As a rule, these tumours occur in middle life. Preceding inflammation or injury is said to dispose to them. Their form is as variable

as their consistence and depends upon the relative amount of the various tissue elements of which they are composed. Most often they are firm, rounded or ovoid and irregular on the surface. They are movable on the deep structures, if they spring from the superficial aspect of the gland, and the overlying skin is not attached to them If left, they tend to enlarge slowly but progressively As a general rule, they are not malignant in the true sense of the word



Fig 343.—Mixed tumour of the parotid gland.

—that is, they do not endanger the life of their possessor and do not cause metastasis although they may recur locally if not completely removed

Mixed tumours cause few **symptoms**, unless they are allowed to grow to a great size They may then be painful and facial paralysis may be observed In the case of parotid tumours, deafness due to occlusion of the external auditory meatus may be noticed. Excess of salivary secretion is more common than diminution. One curious feature with regard to their growth must be mentioned. Often after

slowly increasing in size for years they suddenly enlarge rapidly and many patients then seek advice for the first time. This is an indication that the tumour has taken on the true characteristics of malignancy and the prognosis is then correspondingly grave.

The **histological appearances** of mixed tumours are exceedingly variable. Their name is derived from the fact that on microscopical examination the essential part of the growth is composed of more than one type of tissue. Histological examination



Fig. 344.—Mixed tumour of the submaxillary gland.

usually reveals masses of polygonal, cubical, or elongated cells—the so-called endothelial cells, which form a very characteristic feature. They may be grouped together in irregular masses, or may be arranged in narrow but irregular anastomosing strands, or they may exhibit an acinous-like arrangement suggestive of an adenoma. These cell masses are separated and supported by a variable amount of fibrous connective tissue, which may be dense and hyaline at some parts and more cellular at others. More frequently however it shows a strong tendency to become myxomatous, and is indeed strikingly so over large tracts.

Where these two types of tissue are alone found in the sections examined, the tumour is often regarded as an endothelioma. This term, however ought here to be avoided, since sections from similar tumours of the parotid frequently show in addition to the above, irregular areas of cartilage. In other words, these tumours are really mixed or composite, and there is strong reason for believing that the so-called endotheliomas are merely examples of the "mixed" tumour in which the endothelial like tissue becomes predominant at the expense of the other mixed elements.

The balance of opinion is weighted in favour of regarding these composite tumours as examples of teratomas, derived from cells segregated fairly early in the process of development, i.e. at a point where they still possess the latent power of forming more than one tissue By some, these tumours are regarded as inclusions in the developing gland of misplaced embryonic cells derived from structures in the neighbourhood. On this theory the cartilage found in the gland would be derived from the branchial arches or developing mandible. This, however does not appear to explain the variety of tissues that may be met with in these mixed tumours. The origin of the so-called endothelial cells is also a vexed question. The proof of their origin from the endothelium of lymphatics or of blood vessels is wanting, while other pathologists like Ribbert regard them as truly epithelial.[1]

The **diagnosis** of these tumours is not easy Reliance cannot be placed on any one sign alone it is, however safe to assume that any hard irregular movable tumour in the region of one of the salivary glands which has persisted for some time is probably a mixed tumour The diagnosis can only be established with the aid of the microscope.

Treatment.—This consists in removing the tumour at the earliest possible opportunity It is said that a mixed parotid tumour can be shelled out and that if this is done completely there is little if any chance of recurrence. This, however is not the experience of all surgeons. Butlin, in an interesting paper in the *Lancet* (1904), admitted that recurrence had taken place in several cases in which he thought he had completely removed the primary growth. Further, the recurrent tumour was in nearly all cases more rapidly growing than the primary one. The probable explanation is that an apparently complete enucleation is rarely so in fact. Processes of the growth so small as to be inappreciable to the finger invade the capsule and are left behind. Under the influence of the altered tissue-tension resulting from the operation, they take on a new and rapid growth,

[1] This note on the histology of the mixed tumours is contributed by my colleague, Dr Robert Donaldson, of St. George's Hospital.

and when seen on a subsequent occasion, are often found to be inoperable. It is therefore essential in all cases to remove the whole capsule with the growth. In view of these facts it would seem reasonable to remove the entire submaxillary gland when this is the situation of a mixed tumour

When enucleating a parotid tumour care must, of course, be taken not to injure the facial nerve. It is better not to search directly for the nerve, but merely to avoid wounding any branches which happen to become exposed during the operation

Operative technique.—Mention has been made in connexion with malignant tumours of complete removal of the parotid and submaxillary glands. A brief account of the technique of these operations will therefore be added.

The **parotid** is best exposed by a T shaped incision, the vertical part extending from an inch above the zygoma down directly in front of the tragus to a point an inch below the angle of the jaw A second incision is made extending forwards from this at right angles about half an inch below the zygoma Two flaps of skin can thus be dissected up, and the gland exposed. The external carotid artery should be found at the bottom of the wound and divided between two ligatures. No hard and-fast rule can be laid down about the actual enucleation of the gland but it is generally best to begin below and work upwards. The greatest difficulty will be experienced in removing the posterior deep part which extends down to the spine of the sphenoid. If all vessels are tied as they are met, and the field of operation thus kept bloodless, the gland can nearly always be removed entire by the exercise of patience and care. The facial nerve must of necessity be sacrificed The lymphatic glands which drain the parotid should if possible, be taken away at the same operation.

The extirpation of the **submaxillary** gland is a more simple procedure. An incision is made parallel to and below the mandible, curving slightly downwards in the centre After exposing the gland the facial artery should be sought for at its lower border and tied between two ligatures. When this is done the gland can be enucleated without danger or difficulty

THE ŒSOPHAGUS

BY SIR HUGH M RIGBY, K C V O, M S, F R.C.S.

Anatomy.—The œsophagus extends from the lower border of the cricoid cartilage to the cardiac end of the stomach. Its upper extremity (Quain) is opposite the disc between the 6th and 7th cervical vertebræ. In its course downwards it follows a somewhat sinuous direction, and has two distinct curves to the left side. The first curve to the left extends from its origin to the root of the neck. As the superior mediastinum is reached, the œsophagus tends to regain the mid line, which it attains in the posterior mediastinum about the level of the 5th dorsal vertebra. From this point it again deviates to the left side. It passes through a special opening in the diaphragm, and ends in the stomach opposite the lower border of the 10th dorsal vertebra. Its length is 9–10 in.

It is especially prone to disease in three portions. These are—

1. The upper end, in the region of the cricoid cartilage and larynx, one of the narrowest parts of the œsophagus. It is situated opposite the 7th cervical vertebra, and is, in the adult, 6–7 in. from the incisor teeth. This is a very frequent site of growths and ulcerations. The œsophagus is much flattened antero-posteriorly in this part owing to the close apposition of the cartilage of the larynx and the vertebræ.

2. In the neighbourhood of the bifurcation of the trachea, and in close relation with the left bronchus. The trachea bifurcates just above the body of the 5th dorsal vertebra, and the left bronchus crosses in front of the œsophagus at the level of this vertebra, i.e. about 11 in from the incisor teeth. This part of the œsophagus is also a favourite position for malignant growths. Its close relation to such structures as the trachea, aorta, pleura, and pericardium lends additional importance to the occurrence of growths in this situation.

3. The lower end, at its junction with the stomach, 15–16 in. from the incisor teeth. Here a sphincter is formed by a fusiform thickening of the adjacent circular muscular fibres of the œsophagus and stomach. This lies entirely below the diaphragm. The lumen of the œsophagus undergoes marked narrowing over this portion, extending from the opening in the diaphragm to the stomach, termed the "cardiac canal" (Shattock). The junction between the œsophagus and stomach is shown by an abrupt change in the character of the mucous membrane. This is, again, a favourite position for stricture from malignant growth.

Anatomical relations in the neck.—The deep situation of the œsophagus in the neck renders its exposure difficult. Its most

important relations, laterally are the carotid artery and the jugular veins. The posterior surface of the left lateral lobe of the thyroid is in relation with its anterior surface. The left recurrent laryngeal nerve has close relation to its wall. The trachea lies directly in front, the vertebræ prevertebral muscles, and fasciæ behind.

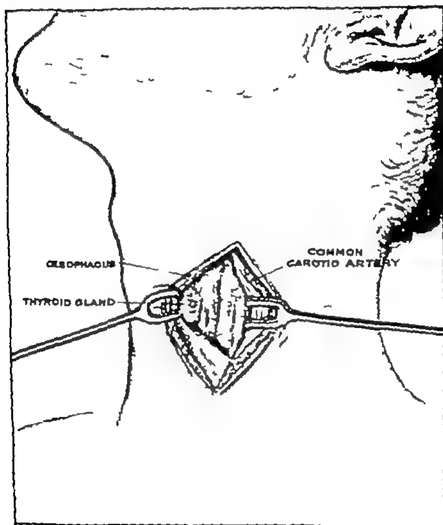


Fig 345.—Structures exposed in the operation of cervical œsophagotomy

Operation for exposure in the neck (*Fig. 345*).—The œsophagus can be satisfactorily exposed by an incision along the anterior margin of the sterno-mastoid muscle on the left side, low down in the neck. The great vessels are identified and drawn out

wards with the sterno-mastoid muscle. The trachea and left lateral lobe of the thyroid are displaced inwards The superior and middle thyroid veins are divided or avoided. The inferior thyroid artery and recurrent laryngeal nerve should be avoided. The œsophageal wall will then be exposed after a little blunt dissection.

Anatomical relations in the thorax.—The œsophagus traverses the superior and posterior mediastina. It is situated immediately behind the lower part of the trachea and the left bronchus, the latter structure crossing it from right to left. It then lies in close relation to the posterior surface of the pericardium and the diaphragm. It passes through a special aperture in the diaphragm and enters the cardiac end of the stomach about 1½ in. below this opening.

It has close relation with both pleuræ. The arch of the aorta crosses in front of it from right to left. The descending thoracic aorta first lies to its left side and then passes behind it, and finally reaches its right side at a point 3 in. above the diaphragm.

Behind the œsophagus are the vertebral column and left longus colli muscle the thoracic duct in the superior mediastinum the vertebral portions of the right intercostal arteries and the vena azygos minor.

The vagus nerves have close relation with its wall forming the plexus gulæ."

Operation for exposure in the thorax.—The œsophagus may be exposed in the thoracic part of its course by cutting across three ribs in two places, namely between their angles and the transverse processes of the corresponding vetebræ. A flap composed of bone and soft parts, is raised up This operation—posterior mediastinal thoracotomy (Bryant)—is carried out at a position depending on the site of the lesion in the œsophagus. The exposure obtained is necessarily much restricted and is unsuitable for other than drainage purposes.

The modern method of exposing the œsophagus within the thorax consists in excising a suitable portion of one rib, usually the 7th or 8th on the left side. The opening thus obtained is widened by the application of a suitable retractor or "spreader. If a more extensive opening is required, the posterior end of the original incision is prolonged upwards, even as high as the 3rd intercostal space and the 4th to the 7th ribs are divided at their angles (Torek).

METHODS OF EXAMINATION

1 **Inspection and palpation**.—These can only be of value when the cervical portion of the œsophagus is affected Tumours of the wall may reveal a swelling to the left side of the trachea. A pouch may form an easily recognizable tumour. Enlarged glands secondary to œsophageal disease may be present.

2. Percussion.—This method is seldom of assistance. A large pouch in the neck may give rise to a tympanitic note, or a greatly dilated œsophagus may possibly occasion altered resonance over the posterior thoracic wall.

3. Auscultation. — By the employment of the stethoscope certain sounds may be heard over the œsophagus during and after the act of swallowing These sounds are due (1) to deglutition, (2) to food entering the stomach. In disease of the wall, especially when a stricture has occurred the interval between the two sounds is increased after swallowing fluids. An obstruction to the passage of food can thus be inferred from auscultation, but this method of examination is uncertain and of little practical value.

4. X ray examination.—Sounds containing metallic cores of lead or mercury are passed down the œsophagus and held in position while the X rays are passed through the thorax and focused on the screen. More frequently in the place of sounds, certain preparations of bismuth or barium are administered by the mouth. Bismuth oxychloride, carbonate or oxide is given in the form of a cachet or suppository paste, or in suspension. For this purpose the oxychloride is preferable to the subnitrate

This method of examination is very valuable in the recognition of strictures and pouches of the œsophagus.

The patient is made to stand or sit with the arms raised and the hands resting on the top of the head. The thorax is so placed that the rays traverse it in the oblique direction, usually from right to left. By this means the shadows formed by the vertebral column and heart and great vessels are avoided. The rays are focused on a screen placed behind the patient who is directed to swallow the prepared emulsion the shadow formed by this substance as it passes down the œsophagus can be easily seen. If a stricture be present the fluid collects at its site and may form a dark mass of considerable size which reproduces the shape of the œsophagus at the site of the constriction. If the existence of a pouch be suspected, the patient is directed to take some bread-and milk or mashed potatoes with which the bismuth salts have been mixed.[1]

5 Direct examination.—By the employment of the œsophagoscope a direct examination of the interior of the œsophagus can be undertaken. Foreign bodies can be seen and their nature shape, and position determined stricture, morbid growths and ulcerations can also be investigated. The instrument devised by Killian and modified by Brüning has many advantages. Its essential parts are shown in Fig 310, a. The important features are the ingenious

[1] *See also* Vol. I., p 683

method of illumination and the ease with which an instrument can be manipulated within the tube.

A valuable addition to the œsophagoscope is the dilating speculum devised by William Hill (Fig 346, c)

The œsophagoscope used by Mosher (Fig 346, B) is oval in shape, and the lamp is placed as in the sigmoidoscope, at the distal extremity of the tube this has certain advantages, but the light is apt to become obscured by the discharge of blood or mucus.

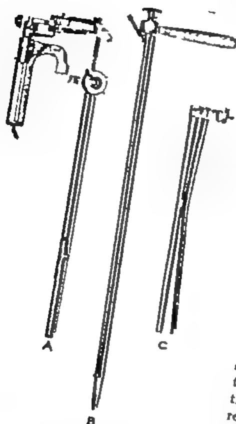


Fig 346 --Instruments used in œsophagoscopy

Br[illegible] Mosher [illegible] Hill [illegible]

Œsophagoscopy may be performed under either local or general anæsthesia. As a rule, it is better to employ a general anæsthetic the examination may take some time and the necessarily constrained position with the head extended is very trying to the patient.

The patient may be placed in the following positions during the passage of the instrument, viz (1) sitting on a stool with the neck extended and the head thrown well back (2) recumbent with the head fully extended. The tube should be warmed and oiled it should then be introduced under direct vision with the illuminating apparatus attached the pilot bougie should never be employed This obviates the risk of perforating an ulcer just below the cricoid or of pushing on an impacted foreign body it also permits the examination of the pharynx during the passage of the tube

Chevalier Jackson emphasizes the necessity of raising the patient's head during the earlier stages the head is not lowered until the level of the aorta and left bronchus is reached The tube is passed

over the dorsum of the tongue until the posterior pharyngeal wall is seen the handle is then tilted upwards, and the introduction continued until the upward movement is checked by the upper incisor teeth. The assistant now inclines the head slightly towards the left shoulder without rotating or tilting the neck and the surgeon slips the tube into the right angle of the mouth and passes it onwards until the right arytenoid eminence and right pyriform sinus are seen. A slight obstruction is often experienced at the position of the crico-pharyngeus, but under anæsthesia this is easily overcome by a little steady pressure and manipulation. The thoracic portion of the œsophagus is easily traversed.

Jackson points out that the head should be moved horizontally to the right, after it has been lowered, in order to pass the instrument through the hiatus" and reach the cardia, as the lower portion of the œsophagus deviates slightly to the left side.

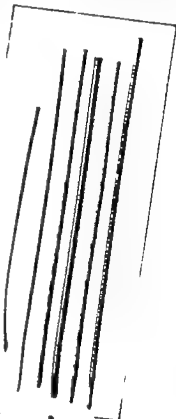


Fig 347 —Bougies for examination of œsophagus.

Bougie with metal acorn tip A, graduated conical bougie C, [illegible] cylindrical bougies B, conical bougie [illegible] bulbous ended bougie.

6 **Examination by bougies.** —The perfection of X ray methods and the extended use of the œsophagoscope have almost rendered obsolete the old method of examination by bougies. It has always been recognized that blind instrumentation of an unknown lesion of the œsophagus is a peculiarly dangerous procedure. It should nowadays never be employed as a means of diagnosis unless the more accurate and far safer methods of X ray or direct examination are not available.

If the use of a bougie is unavoidable the presence of a thoracic aneurysm, as a cause of dysphagia, should first be excluded by careful investigation.

If carcinoma of the œsophagus be suspected, the instrument should be passed with great care, otherwise the ulcerated wall may be perforated or severe hæmorrhage be excited by the point of the bougie.

The instruments used are generally solid flexible cylindrical or oval bougies, which are either conical in shape or have a bulbous end. They are composed of silk web or elastic gum, and are easily malleable when warmed. They are usually 22 in. in length, and vary in size from No. 7 to No. 24 English catheter gauge. (Fig. 347.)

The introduction of an œsophageal bougie is a simple procedure though at first decidedly unpleasant to the patient. When the larynx is reached,

violent expiratory efforts with a closed glottis are generally excited, often followed by retching as the stomach is entered. However, tolerance is surprisingly soon established by custom.

In passing a bougie the surgeon should stand facing the patient. The instrument should be dipped into a basin of warm water lubricated with oil or vaselin, and curved so as to pass easily over the base of the tongue. The patient is then directed to extend the neck and open the mouth. A gag is unnecessary and any introduction of fingers or instruments to depress the tongue should be avoided, inasmuch as it only excites retching and additional discomfort. The point of the bougie is now pushed over the dorsum of the tongue and gently on down the posterior pharyngeal wall, past the region of the larynx, where it is generally arrested by spasm of the inferior constrictor and the narrowness of this part of the œsophagus. With slight gentle pressure forwards, the point then enters and passes down the œsophagus to the site of the obstruction. Any further manipulations must now be carried out with gentleness. If the wall of the œsophagus is ulcerated, considerable pain may be caused by the contact of the bougie. Hæmorrhage may occur and even perforation of the wall has resulted from violent efforts to overcome an obstruction. If the bougie will not readily pass, smaller ones should be tried. If there be a stricture through which a bougie can be made to pass, its extent and diameter can be estimated by means of a bougie with an acorn-shaped extremity (Fig. 347 A).

MALFORMATIONS

The following rare malformations may occur (Whipham and Fagge) —

- Congenital absence of the entire œsophagus.
- Bifurcation of the œsophagus with union of the two divisions towards the lower end.
- Congenital atresia, often associated with œsophago-tracheal fistula.
- Pressure pouches.
- Strictures due to the pressure of a valve-like fold of mucous membrane
- Congenital stenosis of the lower end of the œsophagus.

Only two of these conditions need be considered here, viz. congenital atresia and congenital stenosis.

Congenital Atresia. Tracheo-Œsophageal Fistula

This malformation has more of a developmental than a surgical interest, and little can be done to remedy it.

Loss of continuity of the œsophagus with the pharynx in these cases, occurs near the lower end of the trachea. There is normally a narrowing of the œsophagus about 2½ in. below its origin, marking the origin of the pulmonary diverticulum. In congenital atresia the pharynx and the upper end of the œsophagus terminate blindly just above this region, while the œsophagus ends above by opening into either the trachea or one of the bronchi.

Keith and Spicer show that the trachea and bronchi are derived directly from the foregut through subdivision of the channel by the tracheo-œsophageal septum. The fistula formed between the œsophagus and the trachea in the above-mentioned deformity is the result of failure in union of the lateral ridges which unite to form the septum.

Shattock points out that this does not depend on a failure of communication between the stomodæum and the anterior blind end of the mesenteron. He suggests that the atresia is a secondary process due to kinking of the wall of the mesenteron during the development of the lower part of the trachea and lungs.

In rare cases the upper part of the canal communicates with the trachea. The lower portion may end blindly above without communication with the air-passages, or it may be simply represented by a fibrous cord. The two portions may be connected by a narrow fibrous cord (Lothearsen).

The symptoms produced by this deformity are those of complete œsophageal obstruction, occurring immediately after birth: they are, regurgitation of all food, and continuous discharge of saliva and mucus from the mouth. Respiration is difficult, and cyanotic attacks occur at intervals, increased by attempts to feed either by the mouth or after gastrostomy (Richter).

The condition can be diagnosed by the passage of a bougie or catheter. The prognosis is generally quite hopeless.

Rational treatment aims at closure of the communication of the distal segment of the œsophagus with the trachea, combined with gastrostomy. Two unsuccessful cases have been reported (Richter).

Strictures due to a valve-like folding of the mucous membrane occur either just below the pharynx or near the lower end of the œsophagus.

Stenosis of the Lower End of the Œsophagus

Whipham and Fagge record a case of tubular fibrous stricture of the lower end of the œsophagus in a girl of 4½ years. They could only find records of six similar cases.

DIVERTICULA[1]

Diverticula of the œsophagus occur—(1) at or about the junction of the pharynx with the œsophagus. (2) in the middle third of the œsophagus in close relation with the bifurcation of the trachea and left bronchus. (3) In the lower part of the œsophagus above the diaphragm.

[1] This account of the condition is largely based on excellent papers by Halsted (see Bibliography, p. 313).

From an etiological point of view these pouches are classified as follows:—

1. Pressure diverticula.
2. Traction diverticula.
3. Traction pressure diverticula.

According to Halsted they occur in the following situations, viz. (a) in the pharynx; (b) at the pharyngo-œsophageal junction; (c) at the upper margin of the left bronchus (epibronchial); (d) just above the diaphragm (epiphrenic).

1. Pressure Diverticula

The commonest and most interesting are those found at the junction of the œsophagus and pharynx. They give rise to flask-shaped pouches communicating with the lower end of the pharynx by a narrow opening which has a constant position on the posterior pharyngeal wall at the lower border of the inferior constrictor muscle. Like other diverticula in the alimentary canal, they really consist of herniated pouches of mucous membrane protruding between the fasciculi of the muscular wall. The muscle-fibres generally end more or less abruptly at the neck of the sac, and the main part of the wall of the pouch is composed of mucous membrane covered with an envelope of thickened fibrous connective tissue. As this pouch enlarges it takes the path of least resistance, and therefore tends to protrude on either side of the œsophagus, more commonly the left. It may extend gradually downwards, and its neck become so elongated that the fundus of the sac reaches the mediastinum. It may give rise to a well marked swelling in the posterior triangle of the neck. The gradual enlargement of the pouch is due to food being forced into its interior from above by the contraction of the constrictor muscle of the pharynx.

The etiology of these diverticula has been much discussed. They are said to be congenital but there is no actual proof of this statement. At the lower border of the pharynx, where it joins with the œsophagus, there is said to be a natural deficiency of muscular support, the so-called "Lannier" triangle (Mayo).

There are undoubtedly other explanations of this condition, as Halsted points out. Injury to the œsophageal wall in this region has been followed by pouch formations, and the association of congenital stricture of the upper part of the œsophagus with a diverticulum has been recorded. (*See* Fig 348.)



Fig 348.—Pressure diverticulum at pharyngo-œsophageal junction.
Neck of pouch; 2, œsophagus 3, pouch.
(*Royal College of Surgeons Museum.*)

Symptoms.—Pressure diverticula generally occur in elderly male patients. They often give a history of long standing dysphagia and the first symptoms are merely those indicative of stenosis of the œsophagus, for a long period, unaccompanied by loss of weight or deterioration in health. Later the following symptoms arise If solid food be taken, a feeling of discomfort and pressure is experienced in the neck, as if a foreign body were present. Regurgitation of portions of food occur sometimes shortly after eating, but occasionally at long intervals, even twelve hours, after a meal. Ejection of gas may accompany the evacuation of food by the mouth. The food is undigested and not at all suggestive of stomach contents and when the pouch gets filled, further passage of food down the œsophagus may be completely arrested. The œsophagus becomes pushed to one side, and the pouch comes to lie more directly in a line with the lower part of the pharynx. Pressure on the filled pouch in the neck may be followed by rejection of some portion of the contained

food. The spitting-up of quantities of mucus has been noticed in one case.

Examination of the neck may reveal a swelling situated on either side more commonly on the left, but this sign is often absent. In a recent series of 35 cases reported by Judd a swelling was noticed in 10 7 of these were found on the left and 3 on the right side.

Diagnosis.—The presence of a pressure diverticulum is diagnosed by means of—

(1) An X ray examination.
(2) The œsophagoscope

(1) If a bismuth or barium meal be given, the X rays show a dense shadow situated at the upper part of the thorax, of rounded shape and with a sharply defined outline (Plate 89) A somewhat similar shadow may be produced where marked dilatation is present above a stricture situated in the upper part of the œsophagus in this condition however the lower margin of the shadow is not so definite, and the opaque fluid may be seen to pass through slowly at the lowest point. In a diverticulum, on the other hand, the fluid overflows at a level *above* the lowest limit of the sac.

(2) In examination by the œsophagoscope the point of the instrument usually passes straight down to the floor of the pouch, which is sometimes inflamed and may be damaged unless care be taken. The upper end of the œsophagus is often narrowed and displaced, either forwards or to the right so that its detection may be difficult.

Examination by bougies should be avoided, and is rarely necessary if the above-mentioned methods of diagnosis are available. If a bougie be passed, it generally enters the pouch and its point may be felt in the lower part of the neck. The successive passage of two bougies, one of which enters the pouch and the other the stomach, is sometimes practicable

Mayo refers to a method of diagnosis employed by Plummer. A silk thread is swallowed in sufficient quantities to pass through the stomach into the intestine. A bulbous-ended œsophagus probe is threaded on the silk and passed down. When it can be passed no farther the string is tightened. If a diverticulum be present, the bulbous end is pulled upwards to the mouth of the diverticulum. If a stricture only be present, the position of the probe is not altered.

2. Traction Diverticula

These are of less surgical importance, as they generally remain of small size and may not give rise to any symptoms. They usually occur in the middle and lower portion of the œsophagus. As their name implies, they are generally caused by traction on the œsophagus



Pressure diverticulum as shown by X rays

(Sir Hugh Rigby's case)

PLATE 89

wall This may be due to inflammation of glands or to fibrous contraction following inflammation in the peri-œsophageal tissues.

The structure of the wall of the pouch is similar to that of a pressure diverticulum. The diverticulum is horizontal or the opening may be on a lower level than the pouch itself; hence food rarely tends to collect, and results of pressure do not occur

The pouches are situated on the anterior wall of the œsophagus, just below the bifurcation of the trachea.

The chief danger associated with traction diverticula is the possibility of perforation of their wall by foreign bodies, leading to *hæmorrhage* or *mediastinal infection* *Fistulous communication* with the air passages has also been noted.

3. Traction Pressure Diverticula

These are formed as the result of the passage of food into traction diverticula. They are rarely encountered for the reasons given above.

Treatment of diverticula.—The treatment of œsophageal pouches depends on their size and whether they give rise to much discomfort or actual danger to life. If the pouch be small and obstructive, symptoms be absent or slight the condition may be treated by suitable diet and the occasional passage of a bougie Operation becomes necessary if the pouch when filled, is large enough to cause obstruction to the œsophagus, with resulting loss of nutrition.

Operation consists in exposure of the sac through an incision made along the anterior margin of the sterno-mastoid muscle by careful dissection the sac can be loosened from the adjacent structures and brought up to the surface of the wound. Formerly the sac was then excised by dividing its neck, and the opening into the œsophagus was closed by sutures. Free drainage was provided for and the patient was fed by the mouth or rectum for some days. This method incurs much risk of leakage with possible infection of the mediastinum or formation of a fistula. In order to avoid such risk, the sac is either not opened at all but dealt with *in situ* in various ways (see below) or its removal is undertaken at a subsequent operation. As a rule the latter procedure or two-stage operation, is most commonly adopted. The sac is brought out of the wound and the cavity in the neck packed with gauze, or edges of skin are sutured to the wall of the œsophagus (Fig. 319) after an interval of ten to fourteen days the sac is excised and the opening in the œsophagus sutured. The risk of infection is minimized and the results have been most satisfactory (Murphy Judd Halsted).

The methods adopted for dealing with the sac *in situ* are as follows —

(*a*) If the sac be small, it may be simply invaginated into the œsophagus and secured by sutures. This may cause obstruction to the œsophagus, and for this reason the method is not often practicable.

(*b*) The sac is after dissection, displaced and sutured in such a position that it will not tend to fill with food—diverticulopexy (Hill Dundas Grant)



Fig 349 —Pressure diverticulum (same case as Plate 89)

The pouch has been dislocated out of the wound, and the wound stitched.

(*c*) The sac is dissected free and its cavity obliterated by purse-string sutures (Sipp Bevan)

Other operative methods are (1) removal of the sac and suture under direct œsophagoscopic vision (Gaub Jackson) and (2) division of the septum or party wall by special instruments under direct vision (Mosher)

Results of operative treatment on pouches.—Judd reports 35 cases operated on by the two-stage method or by simple

invagination when the sac was small. There were 2 deaths, and a recurrence of the diverticulum was noticed in 3 cases.

RUPTURE

Rupture of the œsophagus has resulted from over-distension of its wall, previously weakened by disease. In a few cases in which a rupture was found post mortem, no evidence of disease was present.

Bowles and Turner describe the case of a woman aged [illegible] in whom rupture of the œsophagus occurred after a severe attack of vomiting. West and Andrews, Williams, and others have noted similar cases.

The rupture may be a result of severe injuries to the thorax or upper abdomen. In the absence of disease or injury a rupture is an extremely rare event; I could only find one case, and that a doubtful one, in the pathological records of the London Hospital.

It has been suggested that some degenerative change in the œsophageal wall, so-called "œsophago-malacia," precedes, and may be the direct cause of, rupture.

Rolleston points out that simple ulceration and rupture are generally found in the lower part of the œsophagus. In all the recorded cases the rupture appears to have been situated in the neighbourhood of the cardiac end. The tear is longitudinal, generally of small extent, from ½ to 1 in. in length, and is complete, so that the œsophageal contents can escape into the posterior mediastinum. The accident appears to be more common in males than in females. Possibly chronic alcoholism may be a predisposing factor.

The **symptoms** generally occurred in association with or immediately after a severe attack of vomiting. Extreme pain, referred to the lower part of the thorax, both back and front, was usually present. In some of the cases hæmatemesis followed, but generally vomiting ceased after the rupture. Attempts to swallow were followed by severe pain referred to the lower part of the thorax. The pulse was either slow and tense, owing to irritation of the vagi, or small and quick if much shock was present. In the early stage no definite physical signs were noted; later the implication of the mediastinum or pleura gave rise to signs of spreading suppuration in the neck or thorax.

Subcutaneous emphysema was noted in some of the cases reported.

Diagnosis has always been most difficult. It must be well nigh impossible, indeed, in the absence of previous history pointing to disease of the œsophagus.

Surgical treatment by exposing the œsophagus through the posterior mediastinum appears to be the only possible course to adopt. The diagnostic difficulty and the rapidly fatal termination

of these cases account for the absence of surgical intervention up to the present time.

INJURIES

The œsophagus, on account of its protected position, is not frequently injured. Its wall may however, be penetrated from without or from within in either the cervical or the thoracic portion of its course.

1 Injuries from Without

(a) *Wounds of the cervical portion* are more common and include incised and stab wounds and injuries by a bullet.

The œsophagus is not usually injured in self inflicted wounds of the neck. These are generally situated obliquely at the upper part of the neck and open the pharynx above the thyroid cartilage. The rare cases of incised wounds of the œsophagus are generally complicated by extensive injury to the trachea.

Stab wounds of the neck may penetrate the œsophagus with but little injury to the surrounding structures.

The œsophagus has been wounded in rough attempts to perform tracheotomy and in the performance of surgical operations such as thyroidectomy (Berry)

(b) *Wounds of the thoracic portion* are uncommon. They are generally caused by stab or gunshot wounds. Penetration of the œsophagus here generally implies injury to the thoracic viscera, and is most dangerous owing to the certain risk of infection of the surrounding tissues, mediastina, pleura or pericardium.

2. Injuries from Within

These include wounds of the wall inflicted by the passage of foreign bodies, bougies or other instruments. If a pathological condition of the wall is present or ulceration has occurred penetration may be the result of but slight violence. The infliction of damage during the passage of bougies to relieve stricture is not uncommon.

The œsophagus has been wounded by "sword swallowers."

Symptoms and signs of injury.—The symptoms of œsophageal wounds may be masked by those of injury to the neighbouring structures.

Dysphagia accompanied by vomiting of blood suggests implication of the œsophagus attempts to swallow may cause severe pain.

If there be an external wound the presence of food or saliva in the discharge points to a wound in the œsophageal wall. This is more likely to occur if the wound be situated in the cervical portion.

Wounds in this situation caused by the modern bullet are usually

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small and the diagnosis of penetration of the œsophagus is not easy escape of food or saliva is rarely seen unless the wound be a large one (Erbes). Signs of deep infection of the neck supervene, and a spreading cellulitis often leads to a fatal termination

The diagnosis of injury of the thoracic portion of the œsophagus by gunshot wound is even more difficult.

Treatment.—If a wound of the œsophagus be suspected if possible an attempt should be made to close it by suture. Free drainage is essential. Rectal feeding should then be carried out for some days, and subsequently a stomach tube be passed and food given by this means.

FOREIGN BODIES

In children the objects most frequently swallowed by accident are metal toys, pins, and coins. In adults, bones of meat or fish, and other constituents of food too hastily swallowed, may lodge or an ill fitting tooth plate especially when worn at night, is very liable to become detached and slip down the œsophagus.

A proportion of these foreign bodies pass down the œsophagus into the stomach, and are voided in the fæces without causing trouble. Impaction of foreign bodies in the œsophagus is always a source of great danger Those with sharp or jagged edges are very liable to cause ulceration or even penetration of the œsophageal wall. Decomposition of retained particles of food as a result of the obstruction is an additional source of danger.

Foreign bodies tend to lodge opposite the three narrow portions of the œsophagus. By far the commonest site however is the upper part, between the cricoid cartilage and the tracheal bifurcation. Fortunately foreign bodies seldom become impacted in the lower half of the œsophagus, though this may occur if they have been pushed down by instruments used for their extraction. In children, foreign bodies generally lodge about the level of the episternal notch. In hospital practice the impaction of coins at this level is a matter of common occurrence

The **symptoms** produced vary considerably Unless secondary complications arise, but little discomfort may be present. The severity of the symptoms is determined by the site of the impaction and the shape and position of the foreign body

If it be impacted at the upper part of the œsophagus, the larynx may be irritated or actually compressed so that urgent dyspnœic symptoms are excited. But if as is usually the case, the foreign body be fixed near the upper end but below the cricoid, then respiratory symptoms are absent. There is more or less dysphagia, and generally solid food cannot be swallowed. Occasionally the œsophagus is so

completely obstructed that even fluids are regurgitated on the other hand in certain cases, semi-solid food can be swallowed with ease. Constant vomiting may be excited by the lodgment of a foreign body in the upper part of the œsophagus. This was present in a case under my care In another case the impaction of a tooth-plate in the cervical portion of the œsophagus gave rise to severe pain even when saliva was swallowed. Pain referred to the sternum in front, or between the scapulæ posteriorly may be caused by impaction of a foreign body in the lower part of the œsophagus.

When ulceration has occurred, vomiting of mucus streaked with blood may be present.

Foreign bodies may remain lodged in the œsophagus for years and cause but little trouble. They may however soon after impaction, occasion complications accompanied by symptoms of great urgency

The **secondary complications** are —

1 Ulceration of the œsophageal wall at the site of the impaction
2. Formation of a submucous abscess.
3 Perforation of the wall of the œsophagus.
4 Peri-œsophageal inflammation and suppuration in the neck or thorax.
5 Erosion of the trachea or bronchi, with formation of fistulæ.
6. Perforation of large vessels.
7 Inflammation or suppuration in the pleuræ or pericardium.
8. Formation of a cicatricial stricture due to ulceration.

The symptoms caused by these complications are those either of hæmorrhage or of septic involvement of the neck or mediastinum.

Perforation of the œsophageal wall causes severe pain, accompanied by rise of temperature and general malaise. Cervical emphysema generally ensues later

When a large vessel is involved, hæmorrhage may be slight at first it is recurrent, generally ingravescent, and a final severe bleeding may bring about a fatal issue. Perforation of the aorta by impacted coins and other foreign bodies led to a fatal issue from hæmorrhage in five cases reported by Turner

Involvement of the air passages, pleuræ, etc. gives rise to characteristic signs and symptoms.

Diagnosis.—In most cases the diagnosis of the presence of a foreign body impacted in the œsophagus is a matter of no great difficulty A history of the swallowing of the article is often obtainable, but in the case of children this may be entirely absent. Sudden onset of dysphagia in a child without another cause is suggestive of the presence of a foreign body and routine examination as a rule clears up the diagnosis.

In *children* the first step whenever possible is to make an examination by the X rays. Bougies should be avoided unless other methods, such as radioscopy are not available their use requires a general anæsthetic, and may do harm by displacing the foreign body downwards. If the X ray examination reveals a shadow, it will as before stated generally be situated near the upper border of the sternum. The position and size of the body can be determined with accuracy as a rule by this means. Occasionally a coin if impacted in the upper part of the œsophagus, can be palpated in the neck.

In *adults* also it is advisable to employ the X rays as the preliminary step in the examination. As a general rule, foreign bodies can easily be detected in the œsophagus of an adult by this means. The rays must be caused to pass obliquely through the patient, especially if impaction has occurred low down, to avoid the shadows caused by the vertebræ, heart, and great vessels. Metallic bodies are generally recognized with ease, but small portions of vulcanite tooth plates with teeth attached may form so faint a shadow that their detection is a matter of great difficulty In these cases it is a good plan to administer bismuth emulsion, which adheres to the plate. The radiograph plate should be examined in the wet state immediately after its development.

When neither X rays nor œsophagoscopic methods are available, a bougie, preferably a flexible one with a cylindrical metal tip should be passed down. The presence of a foreign body and the site of impaction are then determined.

The œsophagoscope is invaluable for the detection and direct examination of foreign bodies in the œsophagus. It is advisable always to examine with this instrument under general anæsthesia therefore its employment is better deferred until attempts at extraction have been decided upon.

Treatment.—The methods employed for the removal of foreign bodies from the œsophagus are as follows —

1. Extraction by means of instruments through the mouth.
2. Extraction by means of instruments through an opening made into the œsophagus or stomach.

1. In the majority of cases extraction by means of instruments through the mouth is the method of choice, and is generally practicable. Incision of the œsophagus or stomach should only be considered when this has failed. The fact that most foreign bodies tend to become impacted in the upper part of the œsophagus facilitates their removal by the mouth As a rule, treatment should be performed under anæsthesia.

The older methods of extraction by such instruments as the

probang or the coin-catcher have fallen into disrepute, and have, whenever possible, been superseded by the far safer and more exact procedure of working under direct vision with the œsophagoscope. By means of this instrument, in the hands of experts, extraction of foreign bodies of all kinds from the œsophagus has been rendered a

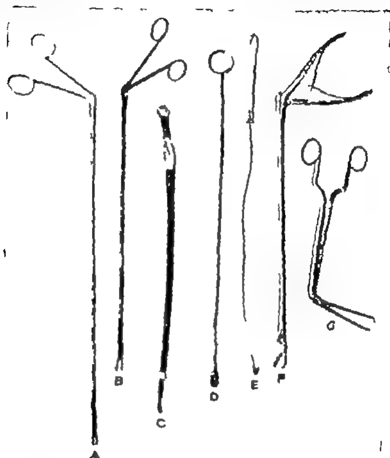


Fig 350 —Instruments used in removing foreign bodies from the œsophagus.

A, Patterson forceps B, Irwin Moore's forceps; C, Ferguson probang; E, coin-catcher; Irwin Moore cutting shears G, laryngeal forceps.

comparatively safe procedure, and the results have fully justified its more universal employment. Special forceps have been devised which can be manipulated within the tube of the instrument, and sharp foreign bodies such as tooth plates can be dislodged, or even cut up *in situ* and extracted piecemeal. (Fig 350, A B.)

The coin-catcher (Fig 350 D E) or special forceps for the ex

traction of foreign bodies from the œsophagus should only be employed if the œsophagoscope is not available. It is made of steel and the handle and stem are in one piece. At the extremity a ring of steel, bent at its middle to an acute angle is soldered to the stem etc. Many accidents have happened as the result of faulty construction of this instrument.

Whenever available the X rays should be used to facilitate the manipulation of the coin-catcher The patient is placed in the dorsal position on a couch beneath which an X ray lamp is placed The coin-catcher is passed down the œsophagus until the obstruction is felt. The room is then darkened and the X ray light is switched on, a hand screen being placed over the front of the neck and thorax The end of the coin-catcher and its relation to the foreign body can be clearly seen, and further manipulation can be performed with exactness.

The end of the instrument is passed downwards until below the foreign body and then drawn upwards. When the coin (or other body) reaches the narrow portion of the œsophagus at the cricoid a hitch is generally felt, but with a little manœuvring this can be overcome. If the foreign body is of an angular shape, the coin-catcher is not of much use, and various forceps should be used for extraction The use of the X rays is invaluable, again for this procedure.

Displacement downwards of a foreign body may be justifiable in the case of smooth bodies, and sometimes if impaction occurs at the lower part of the œsophagus.

Chevalier Jackson maintains that extraction of a foreign body impacted in any portion of the œsophagus should be possible by means of the œsophagoscope. He has removed 238 foreign bodies by this method in a consecutive series without resort to external œsophagotomy He emphasizes the following points in technique —

1. Very careful preliminary X ray study
2. Use of the largest possible œsophagoscope.
3. The foreign body should be moved tilted or rotated as necessary
4. During extraction the foreign body should be kept close up to the mouth of the tube.
5 Avoidance of folds and collapsing wall of the œsophagus.

2. **Extraction by means of instruments through an opening made into the œsophagus or stomach.**—The indications for this are —

(a) When the foreign body cannot be displaced and extracted through the mouth.

(b) When evidence of ulceration of the wall of the œsophagus is present.

(c) When symptoms of perforation of the wall of the œsophagus are present

(d) When complications, such as hæmorrhage or septic infection of the surrounding tissues or thoracic viscera, have supervened.

Cervical œsophagotomy is indicated, as a rule, for the removal of sharp jagged bodies, such as tooth plates, impacted in the upper part of the œsophagus. It is possible by this means to remove, by the introduction of suitable forceps a body situated as low down as the position of the bronchi (Bennett May)

Richardson says that a length of œsophagus 6 in. below the cricoid is accessible by this route. In certain cases it is necessary to cut up the foreign body to facilitate its extraction. In the case of a toy bicycle impacted in the œsophagus, and removed by me, this manœuvre had to be carried out before extraction was possible and the procedure was also necessary in a case recorded by Lawson.

The operation of cervical œsophagotomy is not difficult, but is attended with some danger owing to the risk of septic infection of the tissue planes in the neck. The dissection to expose the œsophagus should be made with accuracy and with as little tearing of the tissues as possible. The opening made in the œsophagus wall can usually be closed by absorbable sutures, and free drainage must be provided —in fact the wound may be entirely left open for this purpose. In most cases a fistula occurs and persists for a short time especially if ulceration be present, but usually it closes spontaneously Rectal feeding is advisable for three days after this operation.

If the foreign body be impacted in the œsophagus at its lower part, it may be extracted from below after gastrotomy According to Richardson 3 in. of the lower end of the œsophagus is accessible for this purpose.

The most difficult problem to deal with is the impaction of a body in that part of the œsophagus inaccessible from above or from below For these difficult cases Bryant has devised and carried out the operation of *mediastinal œsophagotomy* He approaches the œsophagus from the right side, in the case of a foreign body situated below the aortic arch, by resecting portions of three ribs close to the spine The posterior mediastinum is opened up and the œsophagus incised. In this operation there is great risk of infection, and it has seldom been carried out in this country *Fortunately* impaction of a foreign body rarely takes place in that portion of the œsophagus which is inaccessible from above or below It may be possible, by means of forceps introduced through the tube of an œsophagoscope as in a case mentioned above, to displace downwards

a body impacted in this position until it comes within reach of the cardiac orifice.

Gastrotomy is indicated for the removal of bodies situated 15 in. or more below the incisor teeth. The stomach is opened and attempts are made to dilate the cardiac orifice by the finger or a suitable instrument. Careful traction of the stomach downwards with *flexion of the spine renders the cardiac orifice easier of access.*

Results of treatment.—Irwin Moore reports the results of treatment in 60 cases of impaction of a foreign body in the œsophagus: 53 cases recovered and 7 died. Œsophagotomy was only performed in one case. In 47 cases the foreign body was successfully removed under direct vision.

OBSTRUCTION

The conditions which lead to a narrowing of the œsophagus, giving rise to dysphagia, are as follows:—

I. **Intrinsic,** originating in the œsophageal wall.

1. *Spasm* of the muscle coat. Œsophago-spasm. Cardio-spasm. Globus hystericus. Œsophagectasia. Achalasia.
2. *Cicatricial contracture,* consequent upon ulceration of the mucous membrane.
   Causes.—(*a*) Wounds. (*b*) Burns. (*c*) Syphilis. (*d*) Tuberculosis. (*e*) Typhoid fever. (*f*) Peptic ulcers.
3. *New-growths.*
   (*a*) Innocent. (*b*) Malignant.

II. **Extrinsic.**—Pressure on, or invasion of, the wall of the œsophagus from without.

1. Aneurysms. 2. Tumours. Enlarged glands. New growths. 3. Abscess.

INTRINSIC OBSTRUCTION

Spasm of the Muscular Coat

A diffuse dilatation of the wall of the œsophagus associated with contraction of the cardiac opening, or cardio-spasm, occurs in young adults of both sexes. The etiology of this somewhat rare condition has given rise to much discussion, and its treatment to the exhibition of much mechanical ingenuity.

Pathology.—The specimen of which Fig. 351 is a drawing shows the pathological changes usually present. The muscular coat of the entire wall of the œsophagus is hypertrophied, whilst in the lower three-fourths of its extent great dilatation has taken place. The mucous coat is also greatly thickened, and scattered over its surface are numerous shallow ulcers. At the "cardiac canal" the

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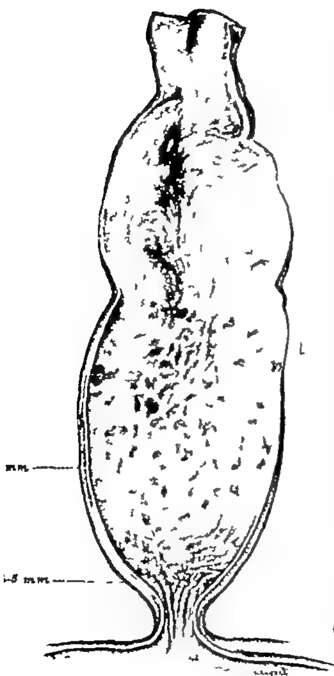


Fig. 351.—Diffuse dilatation of the œsophagus, with cardio-spasm.

(*London Hospital Pathological Department.*)

lumen is much diminished and the mucous membrane is thrown into folds. There is no ulceration seen in this part, and no actual relative hypertrophy of the muscular wall. Such marked changes are found in the chronic forms of the disease.

Brown Kelly points out that the *œsophagus is often* actually increased in *length, and that the* dilatation may be either of spindle or flask shape; if the latter the cardiac orifice may be displaced laterally.

The dilatation of the œsophagus may be fusiform, pear shaped, or S-shaped. In the latter, the rarest variety, a pouch-like condition is formed above the *diaphragm* and the cardia is no longer at the *most dependent* part of the canal (*Lambert*).

Shattock points out that, in œsophageotasis, dilatation and hypertrophy are not generally present in

the cervical portions; the condition is most marked in the thoracic part as far as the diaphragm, whilst below this level such changes are rarely seen. Very occasionally the wall is thickened only and not dilated, in its lower two-thirds (Ellessen Moore).

Etiology.—It is doubtful whether a true primary dilatation occurs irrespectively of obstruction to the cardiac orifice. In most cases the dilatation and hypertrophy are probably secondary and compensatory to a narrowing of the cardiac canal. It has been clearly shown that this narrowing is very seldom accompanied by muscular hypertrophy so that a mechanical obstruction, comparable to that seen in congenital pyloric stenosis, is rarely present.

Authorities differ as to the causation of the narrowing of the cardia. Shattock suggests that two theories should be considered (1) that the obstruction is due to muscular spasm (2) that some alteration in the neuro-muscular mechanism is present which leads to inco-ordinated action of this portion of the œsophagus. The latter view was held by Rolleston. Mikulicz, Meltzer and Leichtenstern agree in thinking that spasm of the cardia is the cause of obstruction, but are unable to explain the spasm. It is probably due, in some cases, to inflammation or actual ulceration of the mucous membrane. Brown Kelly suggests that the spasm is secondary to a hyperæsthesia of the mucosa in the neighbourhood.

Malignant growths at the cardia are often associated with spasmodic contraction of the muscular coat, but the obstruction is then more often mechanical and dependent chiefly on the growth itself. A narrowing of the cardia is, however frequently independent of any pathological change in the mucosa, and unless it be of nervous origin a true muscular spasm is difficult of explanation.

Hurst defines the condition as achalasia, or want of relaxation of this part in the normal act of deglutition. Hill points out that the obstruction takes place at the diaphragm and thinks that it may be due to phrenic stimulation owing to some abnormal condition in the act of deglutition.

Young adults of both sexes may be the subjects of this curious condition, though females of hysterical tendencies are, perhaps, the more frequently affected. The clinical course of the disease is suggestive of a congenital origin.

The **symptoms** may be of long duration, and the intermittent form sometimes lasts over many years. The onset may be either sudden or gradual.

The most important symptom is *dysphagia*. The onset is sometimes acute, and for a time the patient is quite unable to swallow either solids or fluids. A stage of remission follows, with recurrence of symptoms after a variable period. The dysphagia due to mechanical

obstruction differs, in that it is gradual and progressive. Nothnagel points out as a characteristic sign that solid food may sometimes pass down more easily than liquids. Dysphagia is accompanied by a feeling of pressure in the thorax, and sometimes by burning pains radiating to the neck and shoulders. Accumulation of food in the œsophagus gives rise to a sense of fullness behind the sternum, and sometimes colicky pains due to secondary spasm are complained of. These symptoms are relieved by effortless regurgitation of a large quantity of undigested food, mixed with frothy mucus, but free from gastric acids or ferments. Loss of weight and failure of general health only occur in cases of long standing this fact, and the duration and intermission of the symptoms, distinguish such cases from those due to organic stricture. It may be that there is no obstruction to the passage of a bougie although large quantities of food or liquid are retained in the œsophagus.

Examination with the œsophagoscope should be undertaken. In the recorded cases the cardia has been seen constricted, and the mucous membrane heaped up in longitudinal folds so as to give a rosette-like appearance. The surface of the mucosa may be pale, or intensely red, or even ulcerated.

The œsophageal dilatation can be demonstrated by the X rays on the fluorescent screen after the administration of bismuth in food. A fusiform shadow is seen in a typical case by this means the presence of a diverticulum may be excluded. The opaque meal is seen to stop at the level of the diaphragm (Hill)

Examination by auscultation shows retardation or absence of the second swallowing sound.

A bougie, when passed down, stops at the cardiac end of the œsophagus. After a short interval, its point may be made to engage in the opening and be gripped by the constricting muscle. It may then be passed through into the stomach by a little pressure. If this happens, the diagnosis of spasmodic stricture may be confidently made. More often the bougie will not pass nor even engage the stricture. The tube can be moved about abnormally in the dilated œsophagus.

Among other methods of examination may be mentioned the two-tube test of Rumpel and the passage of a rubber-coated sound connected to a eudiometer as suggested by Strauss.

The **prognosis** is unfavourable.

Treatment is difficult, and may only give temporary relief. In early cases, when the condition of the patient is not lowered by starvation, attempts should at first be made to overcome the spasm by the passage of bougies or sounds.

The œsophagoscope should be passed and bougies inserted into

the narrowed cardia under direct vision; this may be extremely difficult owing to the displacement of the cardia or pouching of the lower part of the œsophagus. A rubber bag, dilated, has been successfully employed by Sippey Plummer and others.

A soft rubber dilatable bag is fastened on a bougie, and passed downwards through the cardia. The narrowed part is then dilated by distending the bag with water.

If the cardia cannot be located, nor bougies passed from above, the method of von Mikulicz should be considered. This consists in opening the stomach and dilating the cardia by means of special rubber-coated forceps or by the fingers. A large-sized bougie or bag dilator can then be passed down from above.

In urgent cases, where there is great emaciation, a preliminary gastrostomy may be necessary.

In recent years, direct operative treatment on the lower end of the œsophagus has been performed when dilatation by the above methods has proved to be impossible.

The dilatation of the œsophagus has been reduced by infolding of its wall by sutures—*œsophagoplication* (Meyer).

The narrowed cardia has been enlarged by making a longitudinal incision through its wall and applying sutures so that the vertical wound comes to lie transversely—*cardioplasty* analogous to pyloroplasty (Wendell).

The dilated lower portion of the œsophagus has been brought down through the diaphragm and anastomosed to the stomach wall—*œsophagogastrostomy* (Lambert Zaaijer).

In performing the above operations the œsophagus is exposed by the abdominal or transpleural route.

Fibrous Stricture of the Œsophagus

Etiology.—Fibrous cicatricial stricture occurs as a late result of ulceration of the mucous membrane. This ulceration is generally due to the swallowing of *corrosive fluids* or of *boiling water* but occasionally follows the impaction of a *foreign body* whilst rarely it is *tuberculous* or *syphilitic* in origin.

Pathology.—The formation of the stricture depends entirely on the position, extent, and degree of the burn or injury inflicted on the wall of the œsophagus.

As regards position, naturally the brunt of the injury falls upon the narrower portions of the tube, viz. (1) at its origin (2) opposite the bifurcation of the trachea (3) at the cardiac end.

The burns may be sharply localized to any one of these positions or may extend over the entire wall, causing greater destruction of tissue opposite the narrower portions.

The degree of the burn and the amount of tissue destruction depend on the nature of the fluid and the rapidity with which it enters the stomach.



Fig. 352.—Tubular stricture of the middle third of the œsophagus resulting from the action of a corrosive

(London Hospital Pathological Department.)

The stricture resulting from a localized burn may be only superficial, giving rise to an annular or linear narrowing. This is not common. More extensive and deep burns cause considerable tubular narrowing with much fibrous thickening of the entire wall of the œsophagus. Even the peri-œsophageal tissues are sometimes involved, and their contraction may distort the wall of the œsophagus and lead to a deviation from its natural position. The œsophageal wall above the stricture may be dilated and thinned, but this is not often seen. More commonly a thickening involving the muscular and outer coat is present and extends above and below the stricture. In my experience this is more commonly seen in tubular strictures. (In superficial annular structures dilatation *above* the narrowing is more likely to occur.)

The œsophagus at the site of the stricture, and above and below is generally transformed into a tough, unyielding tube (Fig. 352). Progressive contraction of the cicatrized area gradually occurs, leading to a dense and resistant stricture. The mucosa is usually destroyed, but the

submucous tissue contains large numbers of plasma cells and everywhere shows formation of new connective tissue. The circular muscular fibres are generally much hypertrophied.

Sometimes ulceration of the mucous membrane occurs in the dilated wall above the stricture as the result of the lodgment and decomposition of retained particles of food. Pouches of the wall very rarely take place.

The **diagnosis** of fibrous strictures of the œsophagus due to the action of a corrosive is not difficult. The patient complains of a gradually increasing dysphagia, commencing at variable periods *after the injury. The symptoms immediately following the burn* are chiefly pain and inability to swallow any but liquid food. This condition improves after a few days, when more and more solid food can be taken. After a week or two the symptoms of a progressive dysphagia supervene. The dysphagia is painless and ingravescent, and, unless treatment be adopted, gradually becomes absolute. The diagnosis is confirmed, after the usual routine examination to exclude other causes of œsophageal stenosis, by the introduction of the œsophagoscope and the passage of bougies. If the patient is able to swallow fluids, a suspension of bismuth given by the mouth and the employment of X rays may yield valuable information as to the site and extent of the stricture.

Treatment.—Active treatment should not be commenced until the damaged mucous membrane has recovered sufficiently from the effects of the corrosive. If the burn is a severe one and sloughing has occurred, any form of instrumental treatment may have to be postponed for several weeks. As soon as possible, an examination should be cautiously made with the œsophagoscope. **Dilatation by bougies** should then be attempted under direct vision if the conditions are seen to be favourable. A medium-sized flexible gum-elastic bougie with conical tip is passed down the œsophagus, and very gentle attempts are made to engage its point in the stricture. If any difficulty *is experienced, a smaller-sized bougie must* be tried. If that fails, a filiform bougie or catgut whip should be used. A stiff graduated bougie (Fig. 353, B) will sometimes be found the most useful instrument in locating and engaging the mouth of the stricture. The whip may be used alone, or be directed to the stricture through a hollow bougie which is first passed down to the site of the obstruction. If it be impossible to find the opening by this means, or to pass any bougie, then further operative treatment must be considered.

If a bougie passes through the stricture, dilatation can be proceeded with.

Dilatation can be effected either (*a*) by passing bougies in gradually increasing sizes at intervals of several days (*intermittent*

dilatation) or (*b*) by inserting and leaving in position suitable catheters through which the patient can be fed (*continuous dilatation*).

In children, and in other cases in which much difficulty or distress is occasioned by the passage of the bougie, the latter method will be found most serviceable.



Fig 353.—Bougies for dilating the œsophagus.

A, Railway bougie; B, graduated bougie; C, rubber tube stretched on whalebone. (*Von Hacker*)

(*a*) *Intermittent dilatation.*—The bougie is passed and left in position for a few minutes a larger size is then introduced and kept in for a similar period this is removed, and after a couple of days interval a further trial is made with a bougie of slightly larger calibre. By this means gradual dilatation is effected.

Special forms of bougies have been invented in order to overcome the difficulty of gradual dilatation. The so-called "railway" bougie (Fig 353, A) consists of a hollow gum-elastic bougie, which is passed over a small solid bougie already introduced through the stricture as a guide. By the successive passage of larger ones the stricture can sometimes be rapidly dilated.

Von Hacker has invented an ingenious method of dilating tight and difficult strictures. The instrument (Fig 353, C), consisting of a rubber drainage-tube stretched on a central guide of whalebone or other stiff material, is inserted into the stricture. When the guide is withdrawn the tube shortens and retracts, with corre-

sponding expansion of its circumference. This rubber tube is left in the stricture for some time, and thus the stricture is uniformly dilated. The guide must be well oiled to obviate the difficulty in withdrawal. In my experience this method is unsatisfactory for very tight strictures. A straight, rigid guide is difficult to introduce and to engage in the opening of the stricture.

(b) *Continuous dilatation.*—A hollow tube with a funnel shaped upper end is passed down by means of an introducer and left *in situ*.

Symonds's well-known tubes are of the greatest value and the best for this purpose (Fig. 354 A, B). They are especially useful when there is much difficulty in passing bougies, and if the patient is in urgent need of nourishment. When multiple strictures are present, as is not infrequent, a short Symonds's tube will dilate the upper and perhaps more constricted, portion, and so permit later access to the lower part of the œsophagus (Fig. 354 C, D). These tubes may be left in for a week or ten days at a time.



Fig. 354.—Symonds's tubes

A, Symonds's long tube; B, introducer; C, D, Symonds's short tubes. To the short tubes string is attached so that they may be disengaged and removed.

In strictures in the upper part of the œsophagus the long, upper funnel shaped end is apt to irritate the larynx. In a case of mine this was obviated by cutting down the funnel. The tube is kept *in situ* by silk which comes out of the mouth or nose and is fixed to the auricle. It is a good plan, if the silk is passed out of the mouth, to thread upon it a piece of small rubber drainage-tube. This prevents the possibility of the silk being bitten through if an anæsthetic has been given.

Palliative measures.—If no instrument can be passed through the stricture, then a temporary gastrostomy should be made to permit feeding and to afford rest to the œsophagus. After a few days further

attempts at dilatation may be successful. If, however after a suitable period, bougies cannot be passed down, the procedure adopted by Abbe, Dunham and others is worth a trial. This consists of making the patient swallow one end of a string of silk (Dunham) or of a piece to which a shot has been attached (Abbe) The silk passes down into the stomach and is found and brought out through a gastrotomy opening Abbe employs the string to act as a saw and so divide the constricted portions when this is done a bougie is fastened to the upper end and pulled down from below

When the stricture is placed low down in the œsophagus it can sometimes be dilated from below through the opening in the stomach by the passage of suitable forceps or dilators, or even of the finger. Considerable difficulty is often experienced in this manœuvre, but successful cases have been reported by Kendal Franks and others.

Cutting instruments after the pattern of urethrotomes have been devised for the division of impassable œsophageal strictures (*internal œsophagotomy*) These are always dangerous, owing to the risk of their cutting through the wall and leading to mediastinal infection. They are condemned by most surgeons.

Electrolysis of the stricture has been attempted in a few cases, but the method has little value.

Operative treatment.—*Operations are planned to divide the strictures from without (external œsophagotomy)* or even to excise the stenosed portion. Such operations are indicated when an impassable stricture of small extent is situated in the upper portion of the œsophagus.

Cervical portion.—The œsophagus is exposed as for œsophagotomy and the extent of the stricture determined. If possible, the wall is opened below the stricture, and the latter divided from below upwards bougies are then passed and dilatation effected. The opening in the wall is now carefully closed and free drainage provided. This gives most satisfactory results, but unfortunately is seldom practicable. The stricture is often found to extend into the thorax, so that the incision has to be made either directly over the stenosed portion or above it. It is better in these cases to open the œsop[illegible] above and attempt to find the up[illegible] of the strictu[illegible] can then be enlarged by a cutt[illegible] or by the p[illegible] a probe or staff bougie.

In exceptional cases excision [illegible] segment has [illegible]cessfully carried out (Kendal [illegible] of the employed to make good the [illegible] been [illegible] Hacker)

Thoraci[illegible] recent [illegible] in the thor[illegible] the [illegible]

phagoplastic operation with varying success. The principle of such treatment consists in forming a subcutaneous antethoracic tube which connects the stomach below with the œsophagus above the stricture. The œsophagus is cut across and the proximal end is brought out through an opening made at the lower part of the neck.

Portions of the stomach or intestine in the upper part of the abdomen have been utilized in the formation of the subcutaneous channel.

The Jianu method consists in forming a tube made from a long strip of the stomach wall by two incisions parallel with the greater curvature one end is left attached and the other turned upwards on the chest wall. Jianu and Mayer (Binnie, "Textbook") advocate this method and show that the upper end can be brought up to the level of the third rib

A portion of the jejunum has been isolated, with preservation of its blood supply one end is anastomosed into the stomach and the other implanted in the antethoracic tissues as high as the upper border of the sternum—*œsophago-jejuno-gastrostomy* (Roux). Von Hacker has employed the transverse colon for the same purpose.

The openings of the œsophagus and intestines, which seldom can be approximated, have been united either by a rubber tube or by a tube made of pedicled skin-flaps from the thoracic wall.

Non Malignant Tumours

These comprise polypi, fibromas, myomas, lipomas, warts, and retention cysts (mucous glands). All of them are so rare as to be of little surgical interest.

The polypi are perhaps the least uncommon. They usually occur in the upper part of the œsophagus in elderly males. They are fibrous, and generally contain fat in their structure. The tumour may develop a long stalk, and cases have been published in which the polypi protruded into the pharynx and could be seen through the mouth. The pedicle is generally attached to the anterior wall of the œsophagus below the cricoid. They may give rise to no symptoms, but if large may cause dysphagia, and if protruded upwards may induce attacks of dyspnœa and alteration in the voice.

They are treated by removal, after division of the stalk, by means of a suitable snare.

Polypi have been removed through the mouth. The tumour is ejected and held in position, the pedicle ligatured and cut through. If this be found impossible, it should be removed through an œsophagotomy opening. If situated in the lower portion of the œsophagus (an uncommon site), the tumour might possibly be removed with the help of the œsophagoscope (von Hacker).

Malignant Tumours

Carcinoma of the Œsophagus

It has been estimated that about 5 per cent. of all carcinomas arise in the mucous membrane of the œsophagus. The growth most

commonly begins in the epithelium, and is a typical squamous-celled carcinoma. Less frequently the epithelium of the glands in the mucous membrane undergoes carcinomatous change and develops a tumour



Fig. 355.—Annular carcinoma of upper end of œsophagus.

(Royal College of Surgeons Museum.)



Fig. 356.—Diffuse carcinoma of œsophagus.

(Royal College of Surgeons Museum.)

composed of cylindrical cells (Franke). In 30 cases of malignant disease of the œsophagus Perry and Shaw found 28 squamous-celled epitheliomas and 2 sarcomas. A colloid growth is occasionally met with.

Morbid anatomy —In its early stages the carcinoma is limited to the mucous membrane, and involves only a small portion of the wall of the tube it tends to spread along the surface of the mucous membrane either transversely so as to involve the whole circumference in an annular form (Fig. 355) or longitudinally giving rise to a growth of large extent (Fig. 356). The former condition is more commonly found As the growth extends, it infiltrates the outer coats and may penetrate the muscular wall and invade the peri-œsophageal tissues.

A primary growth in one part of the œsophagus has been found to be associated with other growths lower down, suggesting the possibility of a secondary implantation.

Metastatic growths from œsophageal carcinoma have been recorded, but are of rare occurrence.

Glandular deposits are frequently noted. The lower deep cervical glands on either side are affected when the primary growth is situated in the upper part of the œsophagus. Growths in the thoracic portion lead to involvement of the mediastinal glands.

As the growth extends outwards into the muscular wall it may finally penetrate to those structures in close relation to the œsophagus. Peri œsophageal adhesions and infiltration lead to implication of nerves, viz. the

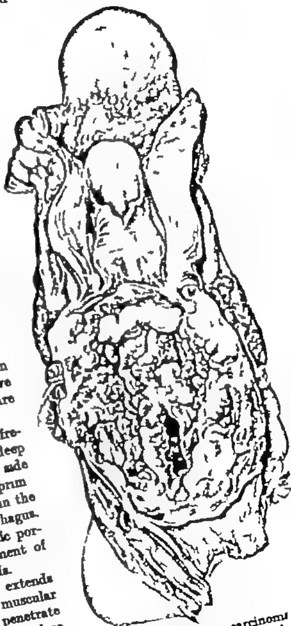


Fig 357 —Extensive carcinom
œsophagus opening into trach
(London Hospital Pathological Depart

vagi, recurrent laryngeal, and sympathetic. Perforation of the large vessels in the thorax or of those portions of the air passages in close relation to the œsophagus, has been noted in many cases (see Fig. 357) Less commonly the pleura and lungs are involved.

Perforation of the lung leads to gangrene and cavity formation, with possible secondary erosion of branches of the pulmonary artery

In 70 cases of perforation into the air passages collected by Zenker and von Ziemssen (Kraus), 26 involved the right or left bronchus, 21 the trachea. In 23 cases the lungs were invaded; the right lung was three times more commonly affected than the left.

The pleural cavity is seldom penetrated. The posterior mediastinum on the right side may be invaded, and a case of extensive subcutaneous emphysema has been recorded as the result.

An œsophageal cancer sometimes extends to the pericardium.

A carcinomatous ulcer situated at the upper or lower end of the œsophagus may spread to the pharynx or stomach respectively At the upper end the ulcer may extend (a) forwards over the cricoid, and involve the arytenoids or larynx, or (b) backwards and become adherent to, or even erode the vertebræ.

Growths at the cardiac end of the œsophagus have been seen to spread for some distance into the wall of the stomach. Also, carcinoma of the cardiac end of the stomach spreads to the œsophagus of 25 cases of malignant disease of the cardiac end of the stomach, in 16 it had invaded the œsophagus for some distance (Fawcett).

It would appear that the growth is sometimes determined by some previous change in the epithelium, such as scarring due to old ulceration from various causes. The common location of the growth in the narrow portion of the wall suggests that irritation may be a factor in its development. It has frequently been noted that œsophageal carcinoma is associated with raised plaques of thickened epithelium scattered over other portions of the mucous membrane. They appear to be analogous with leucoplakia of the tongue, and their association with carcinomatous change is most significant of the presence of some chronic irritation.

Sex and age-incidence.— Carcinoma of the œsophagus is essentially a disease of the male sex. It is estimated that about 80 per cent. of the cases occur in males. A family history of carcinoma was found in 6 per cent. (Rolleston). It is a disease of later life, and but seldom met with before the age of 40 In the female sex it is found to occur at a somewhat earlier period (Rolleston). Its greater frequency in the male sex has been attributed to the greater liability to irritation from tobacco, alcohol, etc. and possibly to the more frequent occurrence of syphilitic lesions.

CARCINOMA

Distribution — Carcinoma tends to arise in certain well-defined areas of the œsophageal wall. It affects the narrow portions of the tube, namely the origin the neighbourhood of the tracheal bifurcation and the lower end

The relative frequency with which carcinoma involves any one of these portions has been a matter of dispute. Mackenzie (1876) maintained that the upper portion of the œsophagus was affected in 40 per cent. of all cases. Other authorities (von Hacker Butlin, Rolleston) favoured the lower portion and the part in relation to the tracheal bifurcation. Von Hacker [Kraus] in 100 cases found that 40 per cent. arose at the tracheal bifurcation, and 30 per cent. at the lower end, whilst only 10 per cent. involved the upper portion. Von Bergmann maintains that the region of the bifurcation of the trachea is the most common situation of cancer Butlin points out that the lower half of the œsophagus is much more commonly affected than the upper. Rolleston notes that in women the upper portion was more commonly affected. Keen states that in 68 per cent. the carcinoma is situated in the lower portion of the œsophagus, between the hilus of the lung and the cardia.

Of 214 cases quoted by Rawling, only 24 occurred in the cervical region, whilst 163 were in the thoracic portion of the œsophagus. Sauerbruch in 186 cases found that 26 were at the commencement, 43 at the bifurcation of the trachea, and 117 at the cardiac end.

Binnie quotes Lilienthal and Gerster who consider the middle third the most frequent site, next the lower third, and lastly the upper third. Janeway and Green attribute 15 per cent. of cases to the upper portion of the œsophagus, 32 per cent. to the region of the bifurcation of the trachea, and 53 per cent. to the lower portion.

Symptoms.—A gradual onset of dysphagia associated with loss of flesh and strength, occurring in an elderly male patient, is generally indicative of the presence of a carcinomatous obstruction in the œsophagus.

The dysphagia occasionally comes on suddenly As a rule, pain is absent until the disease is advanced but even in the early stages complaints may be made of a feeling of tightness in the throat or of vague feelings of discomfort in the chest when food is swallowed. Loss of body weight and of strength is a comparatively early symptom. The dysphagia is at first slight, but later is slowly progressive. A difficulty in swallowing dry solid food is first experienced then semi solid food cannot be taken into the stomach without some delay later only liquids or very finely divided substances can pass down. At a still later stage, fluids tend to regurgitate unless taken slowly and in the final stages, even fluids cannot pass the site of the obstruction. Pain, as previously mentioned, is not an early symptom when it occurs it is generally coincident with the taking of food. It is often referred to the sternum when the stricture is in the lower half of the œsophagus thence it radiates to the back of the shoulders or even up to the throat. If the growth is in the upper part the pain

is referred to the neck on each side. In growths at the cardiac end, pain may be entirely absent.

In the later stages, symptoms arise which depend on the position of the growth and its spread to neighbouring structures. An ulcerating growth at the upper part generally leads to much laryngeal irritation, distressing cough, or expectoration of frothy mucus associated with fetor.

Severe bleeding is rare, unless a large vessel becomes involved, but blood-stained, foul-smelling mucus is brought up in late ulcerating growths situated at any part of the tube. The breath acquires an offensive fetor.

In some cases the voice becomes altered and develops the character suggestive of paralysis of a vocal cord.

In longstanding cases, symptoms of encroachment on the air passages by the growth may develop.

The **diagnosis** is made (1) by a consideration of the above-mentioned symptoms, (2) by certain routine methods of examination conducted in a methodical manner in order to exclude many other causes of dysphagia.

Careful inspection and palpation of the neck should be undertaken to eliminate tumours originating either in the lymphatic glands, the thyroid gland, or the vertebræ. Increased fixation or undue bulkiness of the œsophagus can be noted. Rarely the presence of a pharyngeal diverticulum may be discovered by this means.

Evidence of alteration of the pupils should be noted, or inequality of the palpebral fissure. Signs of venous obstruction, or hyperæmia of one side of the face, are suggestive.

External examination of the thorax should next be undertaken, and the condition of the heart and lungs carefully noted. The upper abdomen should then be palpated for the presence of a possible tumour

The methods to be employed in the internal examination of the œsophagus have been previously described. They include—

1 The employment of X rays and fluorescent screen after the administration of bismuth by the mouth.
2. Examination with the laryngoscope and the œsophagoscope.
3 Examination by sounding (occasionally)

1 **Examination with X rays**.—If carcinoma of the œsophagus be suspected, examination by X rays with the fluorescent screen, after the administration of bismuth or barium should precede any form of instrumental examination.

The presence of a stricture, its site and extent, can be demonstrated by the stoppage of bismuth or barium given in the form of an emulsion or suppository

In early growths with but slight stenosis the bismuth may pass through without an appreciable check. A suppository should then be given: this is often held up at the site of the growth. When stenosis is present the bismuth collects above it and forms an oblong opaque shadow somewhat cone-shaped with the base uppermost. The apex of the cone points into the mouth of the stricture through which the emulsion may be seen to pass down slowly into the stomach. If the emulsion as it passes through the stricture shows a narrow tortuous, and irregular shadow the presence of a growth is certain, and its extent can be estimated by the length of the irregular portion.

Other causes of dysphagia can be excluded. An aneurysm can be demonstrated by a pulsating shadow, and the presence of a pouch or of a foreign body can be easily recognized.

Marked dilatation of the œsophagus above a stricture due to growth is not common, a striking contrast to the condition usually found as the result of cardiospasm (see p. 289).

2. **Direct inspection with the œsophagoscope.**—This method gives the most exact information as to the character and extent of the œsophageal growth. By its means portions of the tumour can be removed for microscopical examination and local applications can be made or radium applied. The employment of this instrument however is not to be advised as a routine method of examination in general practice. The introduction of an œsophagoscope, even under anæsthesia, is a proceeding which entails certain risks and requires technical experience. The diagnosis of an œsophageal carcinoma can generally be confidently made without its use. It is invaluable in cases in which the diagnosis of a malignant growth is doubtful or in which treatment by radium, or some other local application is thought advisable. As seen through the œsophagoscope, a carcinoma of the mucous membrane of the wall can be easily recognized. In the very early stages only a slight swelling may be seen, but in the average case the raised ragged edge of the growth and the ulcerating surface are quite distinctive. The fixation of the œsophageal wall at the site of the growth is a noticeable feature, and the natural rhythmic respiratory movements, which are always present in the healthy œsophagus, are absent.

Examination with the laryngoscope will reveal a growth only when it is situated at the commencement of the œsophagus. This instrument, however should be employed in every case in order to investigate the condition of the vocal cords.

3. **Examination with bougies.**—This method should only be employed when radiography or direct examination by the œsophagoscope is not available. By its means the position and permeability of an œsophageal stenosis can be estimated.

The chief dangers are—(a) perforation of the wall of the œsophagus, already thinned by an ulcerating growth (b) rupture of the sac in cases of aortic aneurysm

The former danger can be minimized by employing a soft stomach-tube in place of the usual gum-elastic or whalebone sound. Careful consideration of the symptoms and physical signs should render the latter risk an unlikely one. Gum-elastic sounds, either oval or round should be used, or Symonds's whalebone sound with an olive-shaped end. The sound is passed as described on p. 274. If an obstruction be felt no attempt should be made to push the instrument forcibly past the constricted part. A smaller-sized bougie should be used and gradually smaller ones inserted, until one is felt to pass the site of the obstruction. By the employment of Symonds's sounds the length of the constricted portion can sometimes be measured.

Treatment.—Operations for the removal of carcinoma of the œsophagus have up to the present time met with but little success. Excision of growths in the **cervical portion** have been only temporarily successful. Records of 15 cases treated by *cervical œsophagectomy* have been collected by Quervain, and these include the well known cases operated on by Czerny Mikulicz, and Garré. The results are gloomy 5 patients died as the result of the operation, and no case survived for longer than thirteen months.

In Czerny's case the upper end of the lower segment of the œsophagus was fixed to the margins of the skin wound, and the patient was fed by means of a tube.

Kocher employs the collar incision, as for excision of the thyroid and describes two cases. A preliminary gastrostomy is necessary and tracheotomy removal of a portion of the trachea or excision of the larynx may be required

The field of this severe operation is a limited one it is only suitable for small growths situated in the upper part of the œsophagus. The risks of infection are great—the mortality is estimated at 36 per cent. (Torek) Direct axial union of the divided ends of the œsophagus, after excision of the growth, is generally impossible. The excised portion has been restored by a tube of skin made of skin flaps from the neck (Ach von Hacker) or the upper end is fixed to the skin, and connected later with the gastrostomy opening by means of a rubber tube.

In the majority of cases carcinoma invades the **thoracic portion** of the œsophagus, and the dangers and difficulty of attempting its removal by operation can be easily understood.

The operation of *thoracic œsophagectomy* is one of great difficulty and of peculiar danger owing to the risk of mediastinitis

and to the effect of the atmospheric pressure on the lungs. The anatomical difficulties of extirpating a growth in this portion of the œsophagus are great. The wall of the œsophagus, unlike that of the intestine, cannot be freely excised with any prospect of a successful union of its divided ends. An end-to-end anastomosis by suture is rarely feasible. If sutures are used they have a tendency to cut out owing to tension and the constant movement of the thorax. The absence of omentum and, more important still, of a serous coat on the œsophageal wall are conditions prejudicial to satisfactory union.

Resection of the growth with closure of both ends should not be attempted, as the proximal end becomes filled with saliva and food contents, and invariably leaks (Meyer). The distal end can be closed with impunity, but the proximal portion must be brought to the surface and drainage provided.

Excision of cancer in the middle portion of the œsophagus by the transpleural route has proved to be an almost uniformly fatal under taking up to the present. The brilliant case reported by Torek in 1913 stands out as a solitary exception. Heroic efforts have been made by Meyer and others to improve the technique, but the difficulties to be surmounted appear to be almost insuperable. Meyer believes that excision can be accomplished with success if only the condition could be diagnosed and treated at a very early stage.

The technique consists in making a preliminary gastrostomy. The growth is then exposed by opening the thorax under intratracheal insufflation, or in a differential pressure chamber. A wide exposure is made by opening up the 7th intercostal space in its whole length, the incision is prolonged upwards, and the 7th to the 4th ribs are divided near their tubercles. The growth is then freed, great care being taken that the vagi are not damaged. The œsophagus is divided below the growth between ligatures, or the growth is excised and the divided ends are closed by suture. The upper end, with the growth, is then loosened from its position and freed from its attachments as it passes up behind the arch of the aorta to the root of the neck. This is the most difficult part of the operation. An incision is made at the root of the neck, and the upper part of the œsophagus and the growth are brought above the clavicle and through the opening on to the surface of the thorax. The growth is then removed and the cut edges of the œsophagus are sutured to the margins of the incision in the skin.

Later the gastrostomy and œsophageal openings are connected together by various means. Torek used a rubber tube. Jiann forms a tube from the great curvature of the stomach. Roux isolates a coil of jejunum, Vulliet and Kelling a portion of the transverse colon

Lilienthal has recently published a second successful case of excision of a carcinoma of the thoracic portion of the œsophagus. He approached the growth by the extrapleural route through the posterior mediastinum after division of the 6th to the 10th ribs, the pleura being unopened. The growth was freed, retracted, and shut off from the mediastinum by a skin flap taken from the chest wall. It was excised at a subsequent operation. The divided ends were united by a tube and eventually surrounded by the skin-flap detached from the chest wall in such a manner that the curled up skin-flap formed a tube continuous above and below with the œsophagus.

Lower-end growths.—Sauerbruch considers that growths at the lower end of the œsophagus are most favourable for removal. They form late metastases and do not spread locally with rapidity The operation is done in two stages. The growth is exposed by a combined abdomino-thoracic route. The œsophagus is either pulled down or a portion of the stomach is brought up through an opening in the diaphragm and anastomosed to the œsophagus above the growth The growth is resected later. The latter method has been successfully employed by Sauerbruch, Zaaijer Ach, and others.

Janeway and Green advocate removal of the major portion of the stomach in cases of growth involving both the lower portion of the œsophagus and the cardiac end of the stomach. Through an abdominal incision the stomach is loosened from its mesenteric attachments. The thorax is opened, and the stomach brought up through an opening in the diaphragm. The pylorus is then divided. The œsophagus is cut across above the growth, and the ends of the œsophagus and pylorus are united by suture. The pylorus is then secured to the opening in the diaphragm. This operation has been carried out with success in dogs.

Palliative measures.—Short of removal of the growth, the indications are to prevent starvation of the patient (which will inevitably ensue) and to add to his comfort.

The increasing dysphagia may be relieved by—

1 The passage of sounds or bougies from time to time.
2. The introduction of feeding tubes.
3 Application of radium.
4. Cervical œsophagostomy
5 Gastrostomy

1 The *periodical passage of sounds* in order to dilate a malignant stricture has some value, but it is not advisable as a routine practice. The passage of the sound may cause bleeding, and no doubt in some cases hastens the spread of an ulcerating growth. The relief obtained is at best only temporary and swelling of the mucous membrane, induced by the sounding, may increase the dysphagia.

2. *Permanent intubation of the œsophagus* by means of Symonds's funnel-shaped feeding-tubes (Fig 358, A) passed through the stricture has been widely employed The tubes are introduced by means of an instrument inserted into the funnel-shaped upper extremity They may be left *in situ* for several months. A piece of silk fastened to the upper end is brought out of the mouth and secured to the auricle or cheek. The patient is able to swallow and enjoy nourishment. This procedure is not suitable for strictures in the upper part of the œsophagus, as the tube is apt to irritate the larynx. The disadvantages are that the tubes get very foul, may require to be frequently changed, and sometimes tend to stimulate the spread of an ulcerating growth. Jacobson recommends their employment so long as the patient can swallow sufficient food by this means. In discussing this method of treatment, Symonds summarizes as follows



Fig 358.—A, Symonds's feeding tube B, William Hill's feeding tube.

(a) In cricoid obstruction the long rubber tube gives good results.

(b) In disease of the central portion of the œsophagus the short tube is advised, though if pulmonary symptoms arise the long tube is substituted for it.

(c) In disease of the cardiac orifice, gastrostomy is preferable to intubation.

Success has recently followed the use of a permanent feeding tube devised by William Hill and consisting of a malleable silver stilette of small diameter surrounded by a rubber tube (Fig 358, B). This is passed through the stricture with the aid of the œsophagoscope It can be used even when the obstruction is at the lowest portion of the œsophagus. The upper end is fixed to the teeth. It is surprising how soon food can be swallowed *beside* this tube, and its presence is sometimes well tolerated.

3. *Radium* has been employed recently in carcinoma of the œsophagus, with some hopeful results. A small tube containing radium is passed down by means of the œsophagoscope, and left for some hours within the stricture. In some cases ulceration and fungation of the growth have disappeared, and the lumen has much increased so that feeding tubes can be inserted (Hill, Finn Morson).

Janeway records 22 cases, 6 of which were improved and 1 apparently cured by radium treatment. Lewin reports favourably on the combined use of radium and X rays. It is very doubtful whether any permanent benefit can be hoped for from this treatment, although temporary improvement has been recorded from time to time.

4. The operation of *cervical œsophagostomy* whereby an opening is made into the œsophagus in the neck, has little to recommend it. It can only be employed when the growth is at the upper end of the œsophagus. The reasons against it are thus epitomized by Fagge —

(1) The greater difficulty and danger of the operation.
(2) The difficulty of making the opening sufficiently below the growth to prevent later involvements.
(3) Discomfort from the flow of saliva over the wound, and risk of local infection of the cellular tissues from this source.

5 Treatment by *gastrostomy* is indicated when intubation has proved unsatisfactory Improved technique has greatly increased the value of this operation. The disheartening results previously experienced through leakage of stomach contents can now be avoided. By any of the modern methods in use a perfectly dry wound can be guaranteed. The results would be better still if only the operation were performed before the patient had reached a state of starvation, as is too often the case.

Leakage of stomach contents after a gastrostomy operation is prevented by the formation of a valvular opening, which is constructed by one of the following methods —

(1) Inversion of a cone-shaped portion of the anterior wall of the stomach round a rubber feeding tube inserted through a small opening and fixed by absorbable sutures. The cone-shaped portion is inverted, and secured either by rows of purse-string sutures after the method of Senn or Abbe, or by means of layers of transverse sutures inserted on the Lembert principle (Kader's operation).

(2) The tube is passed through a small opening in the anterior wall of the stomach, and some inches of the tube are secured in a groove formed by two ridges of the wall sutured over it (Witzel's method)

In each of the above methods the stomach wall is secured to the abdominal wall by sutures.

(3) The principle adopted by Frank and modified by other surgeons

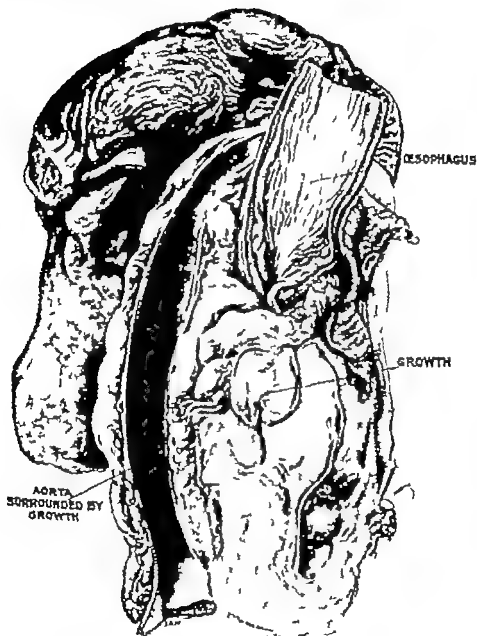


Fig. 359.—Obstruction to the œsophagus caused by a mediastinal growth.

(London Hospital Pathological Department.)

(viz. Kocher Albert and Cheyne) depends on drawing up a cone-shaped portion of the stomach wall which is fixed at its base to the opening in the abdominal parietes. The cone is passed beneath the skin or through the rectus muscle, and its summit fixed to the edges of a smaller opening made either above or to one side of the original incision. By this means a subcutaneous œsophagus composed of stomach wall is formed. The opening into the stomach is finally completed a few days later

All the above methods of operation are valuable. In my experience the operation devised by Senn has given extremely good results. Leakage can be certainly avoided, the operation is very simple, and the patient can be fed immediately

Sarcoma of the Œsophagus

Primary growths of this nature are very rare, but have been reported. They are either spindle- or round-celled, and are sometimes pedunculated. They are more commonly situated at the entrance of the œsophagus, or near the bifurcation of the trachea. The primary growth may lead to secondary bony metastases. One primary lymphosarcoma has been reported.

Secondary sarcomatous growth in the œsophagus is generally an extension from neighbouring bones or soft structures in the neck or thorax The employment of the œsophagoscope is necessary for the correct diagnosis of this condition.

EXTRINSIC CAUSES OF OBSTRUCTION

In any part of its course the œsophagus may be pressed upon or invaded by a tumour or swelling arising in the neighbouring tissues. Such obstruction may be due to aneurysm, enlarged glands, new growths or abscess, and is more apt to occur within the thorax than in the neck. An example of obstruction caused by a mediastinal new growth is seen in Fig 359 For a description of extrinsic forms of obstruction the reader must be referred to other parts of this System or to text-books of Medicine.

SELECTED BIBLIOGRAPHY

Abbe, *Ann. of Surg.*, 1897 xxv 359.
Ach, *Beitr z. Œsoph. Chir.*, 1913, p. 69.
Berry J., *Diseases of Thyroid Gland.* 1901.
Bevan, A., *Surg., Gyn. and Obstet.*, Nov., 1917
Binnie, *Treatise of Regional Surgery*
Bowles and Turner, *Med. Chir. Trans.*, 1899, lxxxiii. 241–55.
Bryant, *Operative Surgery* ii. 1285.
Dunham, *Ann. of Surg.* 1901, xxxiv 822.
Ellissen, *Virchow's Arch.*, clxxii. 501
Erbes, *Centralbl. f Chir.*, 1919, p. 370.
Fagge, Burghard's *System of Operative Surgery* ii. 279.

BIBLIOGRAPHY

Fawcett, *Trans. Path. Soc.*, 1905, lvi. 259.
Finzi, *Brit. Journ. of Surg.*, July 1920, p. 70.
Franke, *Virchow's Arch.*, 1903, clxxiv 563.
Franke, K., *Ann. of Surg.*, 1890, xii. 321–6.
Gaub and Jackson, *Surg., Gyn. and Obstet.*, July 1915, p. 62.
Grant, D., *Proc. Roy Soc. Med.* March, 1918.
Hacker von, in Bergmann's *System of Surgery*
Halsted, *Ann. of Surg.*, 1904; *Surg. Clin., Chicago*, 1919, iii. 607
Hill, William, *Med. Soc. Trans.*, Feb. 13, 1911; *Proc. Roy Soc Med.*, March,
1918; July 1920
Hurst, *Quart. Journ. of Med.*, 1915, viii. 300.
Jackson, Chevalier *Ann. of Surg.*, 1922; Keen's *Surgery* viii.
Jacobson, *Operations of Surgery* ii. 102.
Janeway *Surg., Gyn. and Obstet.*, 1918.
Janeway and Green, *Ann. of Surg.*, 1910.
Jianu, *Deuts. Zeits. f. Chir.*, 1914 lxxxi. 397
Judd, *Surg., Gyn. and Obstet.*, Aug., 1918.
Keen, *Textbook of Surgery*
Keith, Lectures at the Royal College of Surgeons, *Brit. Med. Journ.*, 1910, i. 376.
Keith and Spicer *Journ. Anat. and Phys.*, xli. 52.
Kelly Brown, *Proc. Roy Soc. Med.*, March, 1919.
Kocher *Textbook of Operative Surgery.*
Kraus, in Nothnagel's *Pathologie und Therapie.*
Lambert, *Surg., Gyn. and Obstet.*, Jan., 1914
Lawson, *Clin. Soc. Trans.*, xviii. 202.
Lewin, *Therap. d. Gegenw.*, 1914 lv 103.
Lilienthal, *Trans. New York Surg. Soc.*, March, 1921.
Lotheissen, in Bergmann's *Surgery*
May Bennett, Jackson's *Operative Surg.*, i. 724.
Mayer *Surg., Gyn. and Obstet.*, 1915, xx. 102.
Mayo, *Ann. of Surg.*, July 1909; *Journ. Amer Med. Assoc.*, 1911 lvi. 1437
Mikulicz, von, *Deuts. med. Woch.*, 1904, xxx. 17; in Keen's *Surgery*
Moore, Irwin, *Proc. Roy. Soc. Med.*, Dec., 1918; *ibid.*, 1919, xii. 67
Morison, Clifford, *Brit. Journ. of Surg.*, Jan., 1915.
Mosher, *Surg., Gyn. and Obstet.*, Aug., 1917
Murphy J. B., *Surg Clin., Chicago*, 1916, 391–5.
Perry and Shaw *Guy's Hosp. Repts.*, 1891, xxxiii. 137
Plummer *Journ. Amer Med. Assoc.*, 1911 xxviii. 2013.
Quervain, *Arch. f. Klin. Chir.*, 1890 ii. 858.
Rawling, *Clin. Journ.*, March 2, 1910.
Richardson, *Lancet*, 1887 ii. 707; 1907 vol. ii.
Richter, *Surg., Gyn. and Obstet.*, Oct., 1912.
Rolleston, H. D., Clifford Allbutt's *System of Medicine* *Trans. Path. Soc.*, 1893,
xlv 58; *ibid.*, 1896.
Roux, *Semaine Méd.*, Jan., 1907
Sauerbruch, *Beitr Klin. Chir.*, 1906, xlvi. 405; *Journ. Med. Amer Assoc.*,
ii. 806.
Shattock, *Proc. Roy Soc. Med.*, July 1920; *Trans. Path. Soc.*, 1890 xli. 87
Sippy *Ann. of Surg.*, 1906, xliii. 859–945.
Symonds, in Jackson's *Operations of Surgery* ii. 104.
Torek, *Ann. of Surg.*, April, 1915; *ibid.*, 1915, lxi. 385.
Turner, *Lancet*, May 1910.
Wendell, *Arch. f. Klin. Chir.*, 1910, xciii. 311
West and Andrews, *Trans. Path. Soc.*, 1890, xlviii. 73–7.
Whipham and Fagge, *Lancet*, 1905, i. 22.
Williams, *Trans. Path. Soc.*, 1849, i. 151
Zaaijer, *Zentralbl. f. Chir.*, 1912, p. 1883.

THE STOMACH AND DUODENUM

By JAMES SHERREN C B E, F R.C.S.

Anatomy and physiology.—Although it is customary to describe the stomach and duodenum separately from the embryological and surgical standpoint this differentiation cannot be maintained.

The stomach, and the duodenum as far as the entrance of the common bile-duct, are developed from the foregut, receive their blood supply from the coeliac axis, and are subject to similar diseases. The duodenum below this point is developed from the midgut, is supplied by the superior mesenteric artery and its diseases are those of the remainder of the small intestine.

Our conception of the size and shape of the stomach has changed during
the last few years owing to the frequency of upper abdominal operations
and the introduction of X ray examination after opaque meals. Formerly
regarded as a bag or sac into which the food dropped, it is now known to
resemble more closely the intestine and to be normally in a state of
contraction

It is divided into a cardiac portion, vertical in position, and a pyloric,
which is horizontal and the seat of peristaltic waves. It was at one time
considered that these portions of the stomach were separated by a sphincter,
the mid-gastric of Home; this has been proved to be incorrect.

Much of our knowledge is due to the work of Barclay and Hurst.
It is impossible to say that any one type of stomach, as seen by X ray
examination, is normal, and it must be remembered that it may differ in the
two sexes. Carman points out, quite truly that the shape of the stomach
accommodates itself to the build of the individual, and that a low stomach
in the "visceroptotic" type of person cannot be considered an abnormality

X ray examination shows that the stomach is tubular and usually
J-shaped, the greater part being to the left of the mid line and its lowest
part reaching to the umbilicus. When the tone of the walls is normal,
increase in capacity is obtained by lateral expansion.

Hurst describes three types of normal stomach (Figs. 360, 361, 362),
and this is in conformity with the writer's experience. In 1910 Schlesinger
described four varieties of gastric tone, only two of which he considered
normal. Hurst's classification is an advance on this, and suggests also a
possible explanation of the etiology of gastric and duodenal ulcer. The
hypertonic stomach is associated with hyperchlorhydria; this fact is
important in the etiology of chronic duodenal ulcer

Investigations at the Jefferson Medical College, Philadelphia, on the time taken by various foods to leave the stomach, also revealed two types one which emptied rapidly the other slowly In some cases there was as much as an hour's difference between them.

The time at which food leaves the stomach varies also with the nature of the food; carbohydrates pass out first, then fats and proteins. About six hours after a full meal, or three and a half to four after a light meal, the whole stomach should be empty

Since Beaumont's time it has been considered that the acidity of the gastric contents causes relaxation of the pylorus. But it is more probable that the pylorus relaxes with each peristaltic wave which sweeps over the pyloric portion of the stomach, unless inhibited by reflexes set up by the presence of free acid in the first portion of the duodenum (Pavlov). The presence in the stomach of solid particles, or of fluids warmer or colder than the body temperature, also causes closure of the pylorus.

The capacity of the stomach varies according to the amount and kind

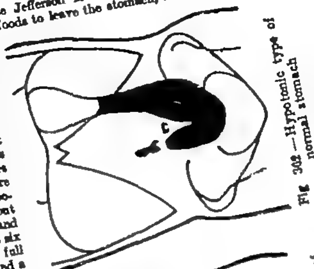


Fig 362 —Hypotonic type of normal stomach

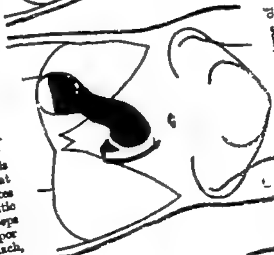


Fig 361 —Hypertonic type of normal stomach

(After Hurst "Brit Med Journ")



Fig 360.—Average normal stomach

of food habitually taken its average, according to Sidney Martin, is 35 to 40 fluid oz.

The function of the stomach is to prepare food for absorption, and so to prevent injury to the intestine; it renders the taking of meals possible, to a certain extent it sterilizes the food, corrects it to the body temperature, and reduces it to a fluid mixed with gastric juice.

The *duodenum* is that portion of the small intestine between the pylorus and the duodeno-jejunal junction. For the purposes of descriptive anatomy it is customary to divide it into three or four parts. From the surgical point of view the important division is into the part above (supra-ampullary) and that below (infra-ampullary) the entrance of the common bile-duct. The supra ampullary portion is affected by the diseases that attack the stomach, whilst diseases of the infra-ampullary part are rare and resemble those of the remainder of the small intestine.

At the level of the junction of the first and second lumbar vertebræ the gut turns directly forwards at the duodeno-jejunal flexure to become the jejunum. The anatomy of this region is of importance in connexion with the operation of gastro-jejunostomy (p. 421). The duodeno-jejunal junction is held in position by a band of fibres containing unstriped muscle attached to the left crus of the diaphragm; this is enclosed in a peritoneal fold which is usually small, but occasionally as pointed out by Mayo, may extend several inches along the jejunum. Murphy has shown that in the process of development a loop of jejunum may be left posterior to the peritoneum. This may extend as low as the brim of the pelvis, and then, passing backwards and upwards, may enter the peritoneal cavity through its posterior wall, just below the level at which the duodenum crosses the aorta. The whole of the small intestine has been found in a secondary sac bounded by omentum and mesocolon.

When the jejunum is turned over to the right, folds are seen running from the duodenum and jejunum to the parietal peritoneum. Of these, the inferior and superior bounding small recesses with their openings directed upwards and downwards respectively are most often seen. Herniæ may occur in this situation, and may not only complicate the operation of gastro-jejunostomy but render it entirely impracticable.

Blood supply of stomach and duodenum.—The stomach and supra-ampullary part of the duodenum are supplied with blood from the branches of the cœliac axis.

The remainder of the duodenum is supplied from the superior mesenteric artery by means of its inferior pancreatico-duodenal branch. The superior mesenteric vessels have an important relation to the third part of the duodenum, in that they cross its middle and by the pressure produced may cause definite symptoms.

The veins of the stomach and duodenum pass to the portal system.

In a study of the distribution of the arteries of the stomach and duodenum, Reeves found a special arrangement in the first part of the duodenum and along the lesser curvature. The plexus formed in the submucosa of these regions is made up of smaller and longer arteries, which run a very tortuous course to reach the mucosa. This may have a bearing on the causation of chronic ulcer

Lymphatics.—Knowledge of the lymphatic system of the stomach is essential to the correct surgery of malignant disease. The present operation of partial gastrectomy for carcinoma is based upon the researches of Cunéo, published in 1900. His results have been confirmed and extended

by Dobson and Jamieson, on whose work the following account is founded.

The lymphatics form submucous, muscular and subserous plexuses continuous throughout the whole of the stomach and communicating with those of the duodenum and œsophagus. From the subserous plexuses the vessels pass to the lymphatic glands into which they drain.

The main groups of glands are the following (Fig 363) :—

1 The *coronary set* lie along the descending branch of the coronary artery and are divided into two groups, upper and lower The lower lie close to the lesser curvature and increase in size and number as they approach the cardia. The upper lie in the falx coronata with the stem of the artery The *paracardial* are outlying members of this group, and lie around the cardia, sometimes extending to the left of the cardiac orifice ; occasionally there are

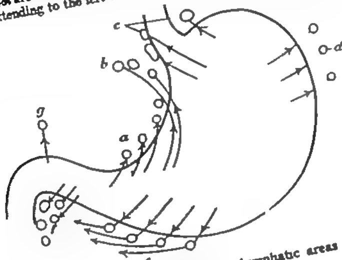


Fig 363.—Lymphatic glands and lymphatic areas of the stomach.

a, Lower coronary glands b, upper coronary glands paracardial glands d, outlying glands of left suprapancreatic group right gastro-epiploic gland f subpyloric glands g suprapyloric gland

e or two glands on the bare area of the stomach. On tracing the upper ronary glands backwards they become continuous with those around the celiac axis.

2 The *cœliac glands*, situated at the upper border of the pancreas, have been divided into three groups, the middle (around the cœliac axis) left (on the splenic), and right (on the stem of the hepatic artery) suprapancreatic To the left suprapancreatic group (splenic) belong the glands occasionally present in the gastro-splenic omentum. The efferents from the suprapancreatic glands pass to the receptaculum chyli and communicate freely with the superior mesenteric glands.

3 The *right gastro-epiploic group of* glands lie below the artery of the same name. They are from four to seven in number and have a tendency to stray downwards between the layers of the great omentum. The vessels from these glands pass to the subpyloric group.

4 The *subpyloric glands* are of great surgical importance They are in relation to the head of the pancreas in the angle between the first and second

in the umbilical region. Hurst came to the conclusion that "the œsophagus and anal canal are almost always sensitive to heat and cold the stomach rarely if ever and the colon to a limited extent in a very small number of cases. Whatever the explanation of the recognition of ice and hot water most of the pain complained of in diseases of the organs with which we are dealing is reflected and not direct.

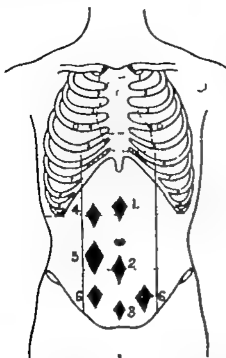


Fig 364.—To show the areas where hyperalgesia is elicited when present. The width of the shaded areas does not denote lateral spread, but merely represents degree of intensity of reflex in typical cases.

Gastric and duodenal area. 2. Small gut area maximum point at junction of upper and adjacent fourths of line drawn from umbilicus to symphysis pubis. 3. Great gut area maximum point at junction of lowest and adjacent fourths of line drawn from symphysis pubis to umbilicus 4. Gall-bladder area the maximum point is situated where horizontal line drawn from the tip of the tenth rib crosses vertical line drawn midway between the nipple line and the middle line of the abdomen. 5. Appendix area maximum point at junction of inner and middle thirds of line drawn from the anterior superior spine to the umbilicus. 6. Fallopian tube area maximum point at junction of lowest and adjacent fourths of line drawn from the middle of Poupart ligament to the umbilicus.

(*After Ligat Brit Med. Journ.*")

Pain resulting from disease of the stomach is most often complained of in the epigastric region, particularly on the left side, also posteriorly at the lower angle of the left scapula. It may be associated with tenderness (hyperalgesia) both superficial (cutaneous) and deep, and with increase of reflexes or muscular rigidity

Cutaneous hyperalgesia.—Considerable interest in this subject has recently been excited by Ligat's Hunterian Lecture. He described an area of maximum hyperalgesia midway between the ensiform cartilage and the umbilicus in certain cases of disease of the stomach and duodenum. The writer can confirm this observation. The result is often striking, the patient evincing signs of considerable distress. In order to elicit it the method Ligat described must be followed. Failure has been due in many cases to too great gentleness. A fold of skin in the left hypochondrium should be picked up and pinched to obtain the normal response. A similar pinch should then be applied to those spots which yield the maximum

response when various organs are diseased (see Fig. 361) Undoubtedly present in many cases of gastric and duodenal ulcer and carcinoma, its presence does not indicate, nor does its absence negative, "gross" disease

Although *deep tenderness* is seen in its most exquisite form in cases of recent perforative peritonitis, pronounced deep tenderness is often present without peritonitis. The muscular and subserous layers of the abdominal wall are supplied from the same nerves. Head and the writer have shown that the afferent fibres running with motor nerves, when stimulated as the result of pressure, cause pain and the painful contractions of muscles are also well known I believe that deep tenderness is often "reflected" but in peritonitis the nerves themselves are directly affected by the inflammation of the parietal peritoneum. Stimulation of these nerves subserving deep sensibility is the cause of the widespread muscular rigidity in diffuse peritonitis.

The *localised rigidity* which may be manifest in a segment of the rectus in many cases of stomach disease is due to increased briskness of the reflex, and does not indicate peritonitis. It is not present on gentle handling, and is associated with deep tenderness on the other hand the rigidity accompanying the deep tenderness in peritonitis is permanent, and will be felt with the gentlest handling

To recapitulate, the pain, tenderness, and muscular rigidity in disease of the stomach and duodenum unaccompanied by peritoneal irritation are reflex, due to the heightened excitability of certain segments of the spinal cord receiving abnormal impulses from the affected viscus.

The important points to elicit with regard to the pain are—(1) Its character position, and spread. (2) Its relation to food the time at which it appears does it waken the patient at night? (3) Is it relieved by vomiting or by taking food, drugs, or fluid, or by rest? (4) Is it accompanied by flatulence or relieved by the passage of flatus?

Vomiting.—Vomiting is nearly always met with during the course of any surgical disease of the stomach or duodenum. But while rarely absent at some time in the course of gastric disease, it is unusual except as a late complication in certain duodenal diseases.

The important points to investigate are—(1) Its frequency (2) Its relation to food. (3) Is it self induced? (4) Does it relieve pain? (5) Its colour odour etc. (6) Does it contain blood?

(See also under Examination of Vomit, p. 325)

Hæmorrhage.—Bleeding more or less severe probably occurs in all diseases accompanied by a breach of surface of the mucous membrane. Blood may be vomited (hæmatemesis) or passed per rectum

(melæna) If a large amount is poured out it may be vomited at once and is easily recognised if poured out in small quantity it is altered in colour and becomes coagulated in tiny brownish-red masses resembling coffee-grounds. Death may result before the appearance of any blood externally but this is unusual. While the presence of any large amount of blood is obvious, smaller amounts should not be overlooked for their importance is great.

Appetite.—Information with regard to appetite is important. In some cases of carcinoma of the stomach, loss of appetite or distaste for food is the first sign of the disease. In duodenal ulcer the appetite may be good and the patient may say that he eats more during the attack of pain than at any other time or as in some cases of gastric ulcer the appetite is good, but fear of the consequent pain restrains the patient from satisfying it.

Jaundice.—This is a rare complication and arises as the result of obstruction to the biliary passages from pressure or involvement in new growth adhesions or contraction of a duodenal ulcer or direct spread into the pancreas. It is more often met with in diseases of the duodenum than of the stomach where it is usually a late result of carcinoma

Physical examination.—While special examinations are necessary in most cases, they should not supersede the routine methods employed to investigate disease in other parts of the abdomen.

The age and general appearance of the patient must be taken into consideration. The condition of the teeth must be carefully looked to it may be thought that the symptoms can be accounted for on dental grounds, but in any case no operation on the stomach or intestines should be done, unless in an emergency until septic stumps have been removed and the mouth rendered as sterile as possible.

For the physical examination the patient should be lying comfortably on a couch with the shoulders a little raised the whole of the abdomen and the lower part of the thorax must be uncovered—many tumours have been overlooked through neglecting this precaution.

The hand should never be placed on the abdomen until **inspection** has been thorough. Note should be made of the general condition of the abdomen and of obvious signs of tumour localised bulgings, visible peristalsis skin-cracks, etc then special attention directed to the epigastric and left hypochondriac regions, where tumours may be seen descending on respiration which cannot be detected in any other way The narrow upper abdomen so often present in enteroptosis should not be overlooked

Palpation should first be directed towards eliciting the presence of areas of tenderness, superficial or deep or of muscular rigidity. Search must then be made for a tumour its position, mobility and respiratory movement must be investigated. Splashing may be obtained, but is only of importance when found in districts other than those occupied by the normal stomach or when occurring more than three hours after a meal. Peristalsis may sometimes be elicited by gently flicking the abdomen. The size of the liver should be noted. The right kidney should always be examined, and if there is any suspicion of gastroptosis the patient should be seen in the erect position.

The supraclavicular region on the left side must be palpated for evidence of glandular enlargement.

Percussion and auscultation.—Formerly considerable stress was laid upon this method of investigation. It is now known to be unreliable. Moreover the size of the stomach is not of great import ance. The tone, position, and time of emptying cannot be discovered by these methods, which have been replaced by X ray examination after an opaque meal (*see* below)

In every case a thorough **general examination** is necessary. Abdominal discomfort (indigestion) is a frequent symptom in general diseases. Particular attention should be paid to the lungs genito-urinary and nervous systems. Gastric crises of *tabes* should never be forgotten gastro-jejunostomy has been frequently performed for these symptoms.

There are two **special methods of examination** which may be of great assistance—(1) X ray examination after opaque meals (2) examination of the gastric contents withdrawn after a test meal

Attempts were made from time to time to construct an efficient instrument, on the lines of the cystoscope, to permit direct examination of the stomach. This method of investigation has fallen into disuse, as it is realized that not even the whole of the stomach can be explored in this way and that many "gastric cases" are examples of disease in other parts of the abdomen.

1 **X ray examination**.—While X ray examination after the administration of an opaque meal is a valuable method of investigation, it cannot be too strongly insisted upon that the result must be considered in conjunction with the other evidence. Neither from the positive nor from the negative standpoint should too much stress be laid upon its finding, and it should never be allowed to influence against operation.

Barium sulphate or bismuth oxychloride is the substance employed the former is now more often used, on account of its cheapness.

By this mode of examination we can determine the position, tone, and time of emptying of the stomach and the nature of its peristalsis.

In addition, direct evidence of an ulcer or a new growth may be obtained by the presence of (*a*) a niche (Plate 90, Fig. 1) (*b*) an accessory pocket (Plate 90 Figs. 2, 3), (*c*) a stricture either at the pylorus or in the body of the stomach (Plate 91 Fig. 1), (*d*) hour glass or bilocular stomach (Plate 91 Fig 2) (*e*) a filling defect (Plate 91 Fig. 3) (*See also* p 338.)

It was pointed out first by Rieder that the whole of a bismuth meal should have left the stomach in five hours a barium meal leaves more quickly Retention for over this time means some abnormality in the work of the stomach, and is the basis of the six hour meal originated by Haudek and used with such great success by Carman at the Mayo Clinic. The opaque meal should be given six hours before the time at which the patient is to be examined. After screening, the situation of the meal will be seen, and also whether there is any residue in an accessory pocket. Further material is then given, and the tone, peristalsis, etc. are watched

2 **Examination of gastric contents.**—The examination of gastric contents withdrawn after a test-meal may give valuable information and should be carried out in every case

The fasting stomach should be empty On passing the stomach-tube in the morning, any food residue denotes motor insufficiency

As a standard, the Ewald test-breakfast—two large cups of tea with milk and sugar and two rounds of lightly buttered toast—should be given, and withdrawn by stomach tube an hour later The investigation should always be carried out in the same laboratory This has been done in the writer's case by the method used by Panton and Tidy The result given is as follows In the normal stomach free HCl varies between 0·08 and 0·12 grm. per cent., and total acidity between 40 and 50 (c.c. of $\frac{N}{10}$ NaOH)

Recently considerable attention has been directed to the fractional test-meal described by Rehfuss in 1914. By this means, samples of the gastric contents are obtained and may be tested at short intervals until the stomach is empty However valuable the fractional test meal may be from the point of view of research into the work of the normal and abnormal stomach at the present time the writer does not consider that it possesses any advantage over the meal withdrawn at a stated time

Various methods have been devised to avoid the withdrawal of gastric contents, such as the time at which salicyluric acid appears in the urine or iodine in the saliva after the administration of salol or iodipin. No reliance can be placed on any of these tests.

Examination of vomit.—The quantity should be noted as an indication of dilated stomach as also the characteristic yeasty smell and presence of food known to have been taken by the patient some days previously. Blood in large quantities is obvious; in smaller quantities it may be difficult to discover or may demonstrate itself as coffee-grounds vomit. Traces of blood may be proved by the detection of hæmin crystals, by spectroscopic examination, or by the benzidin test. Pus is occasionally found in the vomit from communication with an empyema of the gall bladder, or from rupture of an abscess of the gastric wall or of a perigastric abscess into the stomach cavity. The presence of bile in the vomit is important in cases of duodenal stricture and in regurgitant vomiting following gastro-enterostomy.

Fæcal vomit may be present in cases of gastro-colic fistula.

Microscopical examination may reveal, in addition to fragments of undigested food, various micro-organisms, but this is not a method of great value in the diagnosis of gastric disease.

MALFORMATIONS AND MISPLACEMENTS, ETC.

Congenital malformations and misplacements of the stomach and duodenum are rare. Stenoses may occur at the pylorus, in the descending portion of the duodenum or at the junction of the cardiac and pyloric portions of the stomach (congenital hour-glass stomach); occasionally diverticula are present.

Acquired malformations almost invariably result from contraction of fibrous tissue or from new growth.

Congenital misplacement may be present in situs transversus or in hernia, while the acquired variety may be part of a generalized visceroptosis or may occur as the rare volvulus.

CONGENITAL ATRESIA OF THE PYLORUS

Cases have been described in which the pyloric end of the stomach terminated blindly, or in which only an exceedingly fine communication existed between the stomach and the first part of the duodenum. In all the recorded instances the disease has run a rapidly fatal course. Frequent vomiting from birth should direct attention to the possibility of this condition. Gastro-duodenostomy or gastro-jejunostomy should be performed.

CONGENITAL STRICTURE AND OCCLUSION OF THE DUODENUM

These are rare conditions. Out of 13 cases of congenital occlusion or stenosis of the intestines (other than those in connexion with the rectum) collected by Barnard from the records of the London Hospital, in no instance was the duodenum affected.

Out of 183 cases of congenital occlusion of the intestines collected by

Kuliga, 46 were of the duodenum. Schlegel, quoted by Braun, states that occlusion occurs in the duodenum in 32·5 per cent. of the cases.

There may be a septum, with or without a perforation in its centre, running across the bowel, composed of the muscular as well as of the mucous and submucous coats. The interruption of the duodenum may be complete.

The occlusion is usually situated in the region of the ampulla of Vater (Fig. 365), and is in many cases associated with malformations of other structures. Occlusion is more common than stenosis; in 57 cases collected by Cordes, it was present in 48.

Occlusion or stenosis is occasionally present at the junction of the duodenum and jejunum (5 out of 57 cases, Cordes).

As a rule, vomiting occurs soon after birth, its character depending on the position of the atresia or stenosis, but in the case of stenosis the symptoms

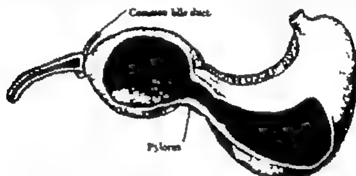


Fig. 365.—Congenital occlusion of duodenum [redacted] a child a few days old. (*Roe and Shaw's case.*)

(*Royal College of Surgeons Museum.*)

may be delayed, one case having been recorded in a girl of 13 (Shaw and Baldauf).

Treatment.—If the condition is recognized, gastro-jejunostomy offers the only hope of saving life.

ACQUIRED STRICTURE OF THE DUODENUM

The obstruction may be in the first part, when it is usually the result of chronic ulceration and in the later stages may bring about obstructive dilatation of the stomach, of which it is the most common cause. Hour-glass duodenum has been recorded as a late result of ulcer; this is interesting rather than important. A stricture in this situation may also result from affections of the pancreas, or from adhesions due to gall-stones.

In the second portion, the stricture is usually the result of carcinoma (see p. 403). In the third portion, it may have the same etiology, but is more often the result of pressure from the superior mesenteric vessels (see p. 337).

Symptoms of duodenal stenosis.—The disease is usually chronic; when produced by pressure of vessels or lodgment of a gall-stone, it may be acute.

DUODENAL STRICTURE

The chronic forms must be divided into two groups—those in which the stenosis is above and those in which it is below the entrance of the common bile-duct. The symptoms of the former are identical with those of stenosis of the pylorus due to disease on its gastric side. When the stricture is below the entrance of the common bile-duct the symptoms are characteristic there is dilatation of both the stomach and the duodenum and bile and pancreatic juices pass readily into the stomach and are vomited. The reaction of the gastric contents is neutral or alkaline. The motions may be colourless, or nearly so.

Treatment.—Stricture of the duodenum should be treated so as to restore as far as possible the normal condition of parts, either by Finney's operation (p. 433) by jejuno-duodenostomy or by posterior gastro-jejunostomy according to the site and cause of the stricture.

CHRONIC DUODENAL OBSTRUCTION OR ILEUS DUE TO PRESSURE OF VESSELS

That pressure on the third part of the duodenum by the superior mesenteric vessels may be a cause of acute gastric dilatation was first pointed out by Rokitansky in 1842. That similar pressure may be the cause of a chronic dilatation was not recognized until many years later Staveley in 1908 and Bloodgood in 1912 called attention to this condition. The writer has recognized it for some time, and first operated for its relief in 1911 It has been brought into prominence more recently by Kellogg and Wilkie.

The condition is more common in women than in men, and is commonly associated with visceroptosis. While the obstructing agent is usually the superior mesenteric vessels, the right colic artery has also been noted (Wilkie) the cause being the drag of the small intestine or in some cases, as demonstrated by Bloodgood a prolapsed cæcum or ascending colon. The dilatation is most pronounced in the first part.

The principal **symptoms** are nausea and vomiting, the former in the writer's cases being marked There are attacks of headache, nausea and bilious vomiting which last usually not longer than a day but there is also complaint of continual epigastric discomfort. X ray examination is often negative.

Treatment.—A thorough trial should be given to non-operative measures—attention to the general health massage, and the wearing of a suitable support. If these fail operation is indicated If the condition results from prolapse of cæcum and ascending colon, fixation rather than the partial colectomy recommended by Bloodgood should be carried out. If this cause cannot be demonstrated

the jejunum should be anastomosed to the third part of the duodenum proximal to the superior mesenteric vessels, as first suggested by Barker of Baltimore and done by Staveley in 1907

The results of duodeno-jejunostomy in this condition are excellent. Two of the writer's patients were operated on over nine years ago, and have entirely lost their symptoms.

GASTRIC DIVERTICULA

These are rare, and usually arise as the result of gastric ulcer Most of them belong to the "traction" group of diverticula, and are the result of the adhesion of the stomach to the abdominal wall liver or pancreas. In rare instances they may result from chronic perforation of a chronic ulcer on the lesser curvature between the layers of the lesser omentum (Fig. 366).

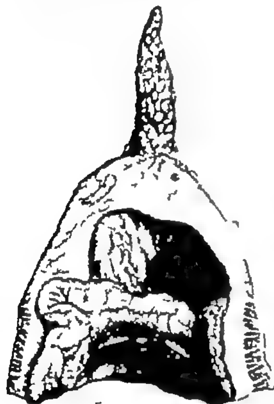


Fig 366 —Diverticulum of stomach between the layers of the lesser omentum due to perforation of a chronic gastric ulcer

Diagnosis can only be made by X ray examination. If the pouch is so shaped or situated as to permit lodgment of food, it may cause symptoms due to its distension or inflammation. This condition usually occurs in women, and should be thought of when with stomach symptoms in a woman, there is a tumour adherent to the abdominal wall in the left epigastric region.

Treatment should be directed to the causative condition. In most cases partial gastrectomy will be necessary

DUODENAL DIVERTICULA

Diverticula of the duodenum are usually situated close to the biliary papilla, are small and formed of the mucous coat only (Fig 367). They may be of congenital origin (Letulle Wilkie) and associated

with the development of the pancreas. Pancreatic tissue has been found in the mucosa in some cases. On the other hand, Keith considers the majority of them to be acquired, and often associated with visceroptosis. They rarely give rise to symptoms, but cases have been recorded in which they have been the cause of digestive disturbance which was relieved by operative treatment. It has been suggested that certain cases of pancreatitis may be due to their presence.

Diagnosis is only possible as the result of X ray examination in this way Cole and Roberts were able to recognize thirty cases.

INFANTILE STENOSIS OF THE PYLORUS (CONGENITAL HYPERTROPHIC STENOSIS)

This is a condition producing symptoms in the early weeks of life and characterized by propulsive vomiting associated with a definite pyloric tumour Among its many names, "infantile" stenosis is



Fig. 367 —Duodenal pouches. (Keith.)

A, A early stage B, small pouch to the right of the common bile-duct C, pouches on each side of the duct.

preferable, as its causation is not certain, and the name often applied to it—congenital hypertrophic stenosis—is therefore misleading

Although the first case of this disease was recorded in 1788 by Hezekiah Beardsley (Osler) as "scirrhus of the pylorus" and reports of isolated cases were published in 1841 and 1842, our real knowledge of the disease dates from Hirschsprung's description in 1888. Cautley and Dent, Thomson, Hutchison and Burghard were early contributors to our knowledge of the condition in this country It is possible that the disease is less frequent here than in the United States; for example in the Babies Hospital, New York, from January 1915, to July 1919 163 cases were operated on. Strauss, in Chicago, has personally operated on 107 cases (1920). On the other hand, at Great Ormond Street, during the three years 1915–17 only 54 cases were admitted, and at the East London Hospital for Children, in eight years to the end of 1917 only 30 cases; at the London Hospital from 1903 to the end of 1919, not more than 29 were so diagnosed.

Etiology —A considerable difference of opinion exists with regard to causation. There are two principal theories—(1) that the

stenosis is primary and due to congenital overgrowth of muscle (2) that it is secondary to pyloric spasm Cautley and Dent uphold the former theory Robert Hutchison Still, and John Thomson the latter The condition has been found in a seven months fœtus, but this does not, of course, exclude the possibility of its being due to spasm in intra uterine life and it has been suggested that this may be caused by hyperadrenalism (Pirie)

It is a true hypertrophy of muscle the typical muscular tumour has been seen still present from four months to four and a half years after successful treatment by gastro-jejunostomy On the whole, the evidence favours hypertrophy of muscle, the result of prolonged spasm. That after birth some condition is added, or the hypertrophy continues to increase, is evident from the fact that the infant takes food well at first and only in exceptional instances does the vomiting begin before the second week of life. This may be the result of gastritis or added spasm, as suggested by Tyrrell Gray and Pirie, due to phimosis (in the male) or to pancreatic insufficiency in consequence of diminished supply of secretin.

Infantile stenosis is more frequently met with in male than in female children (80 per cent. males)

The stomach is large and has thickened walls. The pyloric region feels firm and on section shows great thickening due to hyperplasia of the circular muscle-fibres, sharply limited on the duodenal side, but extending for some distance into the pyloric antrum (Figs. 368, 369) The pyloric canal may be completely blocked to the passage of fluid, although a probe may pass readily The mucous membrane in the pyloric region is thrown into longitudinal folds (Fig 370) As Cautley and Dent have pointed out, "A single longitudinal reduplication of the mucous membrane, much more marked than any other fold, forms a conspicuous feature in many of the specimens. This prominent fold may be compared to the verumontanum of the male urethra. Indeed, these stomachs in appearance commonly resemble the dissected-out bladder and prostate."

A chronic gastritis often complicates these cases, and aids in the production of the obstruction.

Symptoms.—These are characteristic. The child is perfectly healthy at birth and in most cases is breast-fed for about a fortnight and does well. Vomiting, however may begin as early as three days or as late as six weeks after birth. It is forcible, projectile, contains mucus, and occurs sometimes after every feed, at others after three or four have been retained. Bile is never present in the vomit. The food is changed there is apparent improvement in many cases for a few hours or a day but relapse inevitably occurs.

Fig. 308.—Infantile pyloric stenosis, showing great increase in the muscular coat.

(London Hospital Museum and Pathological Institute.)

Fig. 309.—Section of specimen depicted in Fig. 308 showing increase of muscular coat in the pyloric antrum and abrupt termination towards the duodenum.

Considerable delay in the adoption of proper treatment is often occasioned by this intermission The child loses weight and becomes constipated.

If the abdomen is examined shortly after a meal, the dilated stomach may be seen standing out like a small ball, and peristalsis noticed passing across the epigastric region from left to right a tumour resembling an acorn in size and shape may be felt, and its detection clinches the diagnosis. The remainder of the abdomen is sunken. In some cases tetany develops.

Diagnosis.—The history of vomiting coming on a few days or weeks after birth its projectile character the presence of visible peristalsis and a palpable tumour make a clinical picture which is unmistakable.

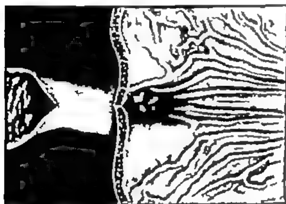


Fig 370.—Infantile pyloric stenosis. Stomach opened to show the longitudinal folds of mucous membrane in pyloric portion.

(London Hospital Museum.)

In doubtful cases X ray examination after an opaque meal may be useful Strauss states that if less than 70 per cent. of bismuth passes through in four hours, operation is necessary

Prognosis.—This is largely determined by the time at which the condition is recognized and treatment instituted. If untreated or treated late, it is almost invariably fatal.

Thus, in 30 cases treated medically at the East London Hospital for Children, all died except one, and in this case the diagnosis was doubtful (Warren). At Great Ormond Street, during the years 1915–17 54 cases were admitted; the total mortality was 80·5 per cent. If the disease can be definitely diagnosed, delay in resorting to operation is not justifiable, for the duration of symptoms before surgical treatment is the most important factor affecting prognosis. Goldbloom and Spence, in reviewing 163 operations at one institution, stated that the death rate was only one-third as high in cases operated on before symptoms had existed for four weeks. The lowest death rate is that recorded by Strauss, less than 3 per cent. in 107 cases. Downes, in 175 cases, records a death rate of 17 1 per cent. but in those coming to operation within four weeks it was less than 8 per cent.

A small percentage get well under medical treatment, but it may be doubted if these are true examples of the disease. John Thomson has traced children so treated up to the age of 16½ and states that they have remained well and are in no way handicapped

Maylard Robson, and others have recorded cases of chronic gastric disease in young adults due to congenital narrowness of the pylorus, with dilatation of the stomach and cases have come under my notice in which symptoms of dilatation of the stomach in early adult life were associated with a history of difficulty in feeding in infancy The relation of these cases to the disease under discussion has yet to be fully worked out

Treatment.—As mentioned on p. 333, immediate operation is indicated in cases that can be definitely diagnosed In doubtful cases circumcision if necessary with small feeds and lavage, may be tried but not for longer than a week. Rammstedt's operation—simple division of the hypertrophied muscle—is the procedure of choice. It is this operation that has caused so great a fall in the operative mortality The two dangers, the risk of encroaching on and injuring the duodenum, and failure to divide all the muscle-fibres, are avoided by making the incision just into the muscular mass and dividing the fibres by blunt dissection so that the mucous membrane protrudes.

Post mortem examination at six and at eighteen months after this operation has shown that all tumour mass had disappeared and that the pylorus was normal.

The **after-treatment** must be carried out with great care. Small feeds should be given in the form of breast feeding or peptonized milk, commencing an hour after operation and repeated every two hours with gradually increasing amounts, so that from the fifth to the eighth day normal quantities are being taken. Saline solution should be given if necessary rectal is preferable to subcutaneous administration. The solution is made with or without glucose and used an ounce at a time at first given every three hours, its frequency is reduced later as more fluid is being taken by the mouth.

HERNIA OF STOMACH

The stomach in rare instances has been found in both congenital and acquired umbilical hernias especially the former in postoperative ventral hernias, and more rarely still as a content of the sac in inguinal and femoral hernias. It is, however most often found in hernia through the diaphragm thus, in 59 cases collected by Lawford Knaggs, the stomach was present in almost all but in only 9 cases was it the sole content.

In most cases the condition is present at birth and observed in infants who are stillborn or who do not survive long In others the opening is congenital but the protrusion of the stomach occurs later in a few the opening results from wounds or ruptures of the diaphragm. A part, usually the pyloric portion, or the whole of the stomach may be involved.

In a few cases in which adult life has been reached, gastric symptoms, such as discomfort after food flatulence or even pain, are present and if the patient is a middle-aged male may lead to suspicion of a chronic gastric or duodenal ulcer ; in other cases, acute dilatation or volvulus of the stomach may supervene. Gastric hernia may be complicated by tetany as in a case recorded by Russell Reynolds. It is a condition that should be borne in mind in obscure gastric cases. The position of the heart and the abnormal area of resonance will point to the correct diagnosis, which will be confirmed by X-ray examination after an opaque meal.

GASTROPTOSIS

In this condition the stomach is displaced downwards, usually in association with the right kidney or all the abdominal viscera. It is more often met with in women than in men, and may cause symptoms owing to its interference with the motor power of the stomach. It should be borne in mind that an unusually low position of the stomach does not necessarily cause symptoms or need treatment.

Etiology.—Gastroptosis may occur in either type of visceroptosis —the virginal, present in long-waisted women with narrow upper abdomen, or the maternal in well built patients with acquired weakness of the abdominal wall. Both types are often present without giving rise to symptoms.

The stomach is usually atonic and dilated. It may assume an almost horseshoe shape allowing the pancreas to appear above the lesser curvature, or in rare cases the pylorus itself may descend and the stomach become vertical.

Symptoms.—It should be remembered that these do not depend upon the abnormally low position of the stomach, but upon *motor* insufficiency from general ill health or from pyloric obstruction.

The patients are often thin, and the subjects of *neurasthenia*. The chief complaint is usually of a feeling of fullness after meals, often *necessitating loosening of the clothes. Vomiting is unusual*, but nausea and retching are common In many cases pain is complained of directly food enters the stomach.

Diagnosis.—The symptoms may mimic those of *chronic gastric ulcer or gastric carcinoma* In the former the intervals which are so prominent a feature of chronic ulcer are usually lacking. In the latter the resemblance may be so great that exploration alone will settle the question. Inspection of the abdomen when the patient is standing will usually reveal the prominent lower belly characteristic of enteroptosis. The lower border of the stomach may often be seen, or X ray examination will reveal its position.

It must be remembered that the presence of gastroptosis does not exclude serious gastric disease and the visceroptotic should not be allowed to obscure other symptoms.

Treatment.—Surgical treatment is only called for in the rare cases in which obstruction due to kinking is present at the pylorus, and is not remedied by medical means, such as rest in bed with the foot of the bed raised combined with abdominal massage and if there is evidence of retention of food gastric lavage for at least three weeks. On the resumption of the erect position a well fitting abdominal belt should be worn.

Many operative procedures have been advised and adopted since Duret sutured the anterior gastric wall to the peritoneum in 1894. They have consisted of various methods of shortening the lesser omentum and fixing the stomach to the abdominal wall. In my opinion, operations of this nature are not more successful than non-operative treatment and in cases with marked obstruction have entirely failed to relieve the symptoms.

Other surgeons have performed gastro-jejunostomy. This should never be done in gastroptosis, for it is in atonic stomachs such as these that the operation is liable to be followed by regurgitant vomiting. For the emphatically rare cases in which operative measures are indicated, I believe Finney's gastro duodenostomy gives the best results, and I have used it with perfect success. When there is associated pressure on the third part of the duodenum by the superior mesenteric vessels, jejuno-duodenostomy should be carried out.

GASTRIC VOLVULUS

In gastric volvulus the stomach may become twisted in one of three directions: (1) Around its transverse axis; (2) around an antero-posterior axis; (3) around an axis at right angles to its greater curvature. This is an extremely rare condition, of which the recorded cases number under 30.

Until the normal relations of the stomach have been altered in some way volvulus is impossible. It may arise in gastroptosis, and has occurred (Knaggs, Payer Dubs) in association with diaphragmatic hernia. It may complicate an hour-glass contraction of the stomach in which the pyloric pouch is large; it has been recorded following injury; in other cases the symptoms have appeared suddenly during apparent health. In most of the cases the stomach became twisted around its transverse axis, the transverse colon passing upwards and backwards. As a result of this, both orifices of the stomach are usually obstructed.

Symptoms.—The onset is sudden, with pain in the epigastric region, followed by collapse. As a rule the patient does not vomit, but only regurgitates food which enters the oesophagus. A tense, resonant swelling rapidly forms in the epigastric region. The signs resemble in many respects those of acute dilatation of the stomach, but diagnosis can be made by the absence of vomiting and by the difficulty of passing a tube from the oesophagus into the stomach.

Treatment.—Operation should be undertaken at once. As soon as the abdomen is opened the stomach presents as a tense cyst which usually needs puncture before the type to which the volvulus belongs can be determined or the volvulus reduced. The opening should be sutured and the volvulus reduced. In the usual type of case (1) the posterior gastric wall presents If the condition is due to gastroptosis, an attempt should be made to fix the stomach so as to prevent recurrence. If it complicates an hour-glass stomach, the appropriate treatment should be adopted, if the condition of the patient permits.

HOUR-GLASS STOMACH (SEGMENTED STOMACH BILOCULAR STOMACH)

In this condition the stomach is divided into cavities, as a rule two but occasionally three or even four It is more often met with

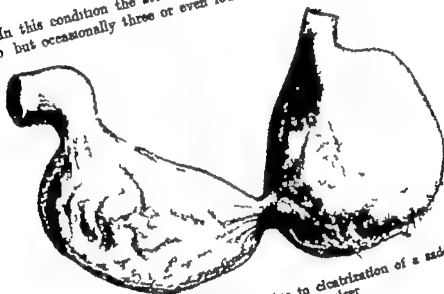


Fig 371 —Hour-glass stomach due to cicatrization of a saddle-shaped lesser-curvature ulcer

(London Hospital Pathological Institute.)

in women than in men Of 96 patients operated on by the writer to December 1922, all except 8 were women.

Etiology —The chief cause is gastric ulcer (Fig 371) more rarely it results from cancer (Fig 372) A saddle-shaped ulcer of the lesser curvature usually produces the condition, but perigastric adhesions as the result of the ulcer may constrict the stomach or bind it to the abdominal wall or liver so that diverticula are formed Out of the 96 cases operated upon by the writer 83 were the result of ulcer Ulcers other than peptic, such as those resulting from corrosive poisoning, and in rare instances syphilis, may also cause the condition.

Perigastric adhesions other than those due to ulcer may in rare instances be the cause.

Extremely rarely the condition may arise congenitally for Delamere and Dieulafé and Gardiner have recorded cases and according to Martin there is a specimen in the McGill Museum As the stomach in the early stage of development consists of a tubular pyloric portion and a cardiac pouch a continuance of the fœtal condition might account for these cases.

The constriction is generally single and situated towards the pyloric end of the stomach, and the greater curvature is drawn up towards the lesser The ulcer producing the constriction has often perforated and is adherent to and eroding the pancreas, or less com-

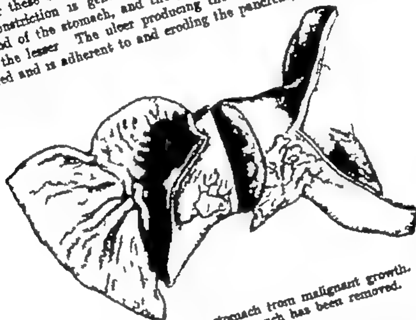


Fig. 272.—Hour-glass stomach from malignant growth. A portion of the cardiac pouch has been removed.
(*London Hospital Museum.*)

monly the liver The cardiac pouch is usually larger than the pyloric When, however as not infrequently happens, pyloric obstruction the result of duodenal ulcer coexists, the pyloric pouch may be so large that the condition may be diagnosed before operation as obstructive dilatation of the stomach. The recognition of this fact is important, for the mistake may be perpetuated at operation, and a gastro-jejunostomy performed on it with a fatal result well known surgeons, among whom are Bier Czerny and Hartmann, have fallen into this error and recorded their experience for the sake of others. A pyloric pouch may become the seat of a volvulus (see p. 330)

Symptoms.—These may resemble those of pyloric stenosis and follow in many cases on the history of a gastric ulcer In others the

suspicious feature may lie in the account given by the patient of long continuance of symptoms without the usual intermissions.

Diagnosis.—Various methods of inflation of the stomach and introduction of fluids were formerly adopted for diagnostic purposes, but these have fallen into well deserved disuse. The fact that the fluid cannot be recovered after giving a test meal, or that a measured quantity used in lavage is not returned, or after returning clear is followed by soiled fluid may lead to suspicion. The *certain* diagnosis can however only be made by X ray examination. Care must be taken in interpreting X-ray appearances of hour-glass stomach. An hour glass appearance due to spasm is a common phenomenon, and is encountered not only in cases of chronic gastric ulcer of which it is one of the indirect evidences, but also in gastric disturbances due to extragastric diseases such as appendicitis or cholecystitis The depression due to spasm is called the incisura or notch.

In this type (Plate 90 Figs. 1 3) the stomach is B-shaped. In true organic hour glass stomach the upper pouch fills first (Plate 91 Fig. 2), and if both pouches are seen full at the same time the strait between them is long and the cavity of the ulcer may sometimes be seen in connexion with it (Plate 91 Fig 1) ?

In rare cases the constriction is close to the cardia, and the symptoms resemble those of œsophageal obstruction.

No rule can be laid down with regard to gastric acidity in these cases. It may be little altered from normal occasionally when an active chronic duodenal ulcer is present, it may be raised, but in more than 50 per cent. free HCl is absent and total acidity is low

Treatment.—The condition should be treated as ulcer without this complication. In many cases partial gastrectomy must be done this was the case in 65 out of the writer's 96 cases. If no active ulceration is present, gastro-jejunostomy to the cardiac pouch may be carried out, but if as is by no means unusual a duodenal ulcer exists as well producing pyloric stenosis, then a double gastro-jejunostomy must be performed, if there is no indication for partial gastrectomy

Other operations have been proposed, such as gastroplasty or a gastro-gastrostomy alone but Paterson has shown that these are associated with 25 to 30 per cent. of relapses

Results.—In 89 operations at the Mayo Clinic the death rate was 7·4 per cent. There were 5 deaths among the writer's 96 cases all those operated on over two years ago, with one exception remain quite well. It must be remembered that in many of these cases the ulcer producing the obstruction is extensive and of long standing, necessitating radical treatment.



Fig. 1.—Penetrating ulcer showing niche (arrow on right) and incisura or notch (arrow on left). ([illegible])



Fig. 2.—Penetrating ulcer showing accessory pocket. ([illegible])



Fig. 3. Spasmodic hour glass stomach, showing accessory pocket. ([illegible])



Fig. 1.—Hour-glass stomach with large pyloric pouch, due to cicatrization of a chronic duodenal ulcer. (*Gilbert Scott.*)



Fig. 2.—Chronic gastric ulcer: hour-glass stomach; large cardiac pouch shown. (*Gilbert Scott.*)



Fig. 3.—Carcinoma of stomach, showing filling defect. ([illegible])

PLATE 91

ACUTE DILATATION OF THE STOMACH

This condition is by no means uncommon Its diagnosis is of the
utmost importance to the surgeon following as it sometimes does ab
dominal operations, usually with a fatal result unless recognized early

Although its recognition dates from the description given in the
Guy's *Hospital Reports* of 1872–3 by Hilton Fagge Rokitan in
1842 had drawn attention to one of the features connected with it
—compression of the third part of the duodenum by the mesentery
and superior mesenteric artery as a cause of intestinal obstruction
due to external pressure Albrecht in 1899 was able to collect
19 cases only by 1902 Campbell Thomson published the record of
44 cases, including 5 in which he had made the post mortem examina
tion. Since then many more cases have been published Laurich
grevink in 1913 analysed 111 cases recorded since 1895

Etiology—The condition may arise after operation performed
on any part of the body but most often follows those upon the
abdomen. It may complicate pneumonia or typhoid fever be asso-
ciated with spinal deformity appear after injury or in rare cases
be the result of indiscretion in diet

It may be met with at any age, the youngest recorded being 9 months
the oldest 73 years, but it is most common between 20 and 40 Sixty per
cent. of the cases have occurred in women

Of the 168 cases collected by Doolin, 69 per cent. followed operations,
the majority of which were abdominal

Many opinions have been advanced as to its cause (1) Obstruc
tion of the duodenum by the superior mesenteric artery (Rokitan
sky Albrecht) (2) excessive secretion (Fagge, Henry Morris) (3)
paralysis (Campbell Thomson) (4) compression of the third portion
of the duodenum by the paralysed dilated stomach (Box and
Wallace) (5) septic intoxication

If primarily due to a paralytic dilatation of the stomach it is
certainly kept up or complicated by mesenteric compression, and
this is the undoubted cause in many cases.

Morbid anatomy.—The post mortem appearances in all the
recorded cases are similar The stomach is dilated into a huge
shaped tube which may fill the abdomen. There is usually
sharp kink at the lesser curvature. The dilatation rarely affects
the stomach alone but may as previously stated stop short at the
point at which the superior mesenteric vessels cross the duodenum
and in one instance (Bäumler) there was a localized constriction here
with a well-defined circular area of necrosis in the intima of the gut
But in some cases the dilatation extends lower and involves the
jejunum to a greater or lesser degree

The *walls* of the stomach are thin, and the mucous membrane shows hæmorrhages. As noted by Fagge, whitish striæ are frequently observed on its peritoneal surface, the result of distension.

If an abdominal operation has been performed there is usually no trace of peritonitis.

Symptoms.—The onset is, as a rule, sudden in the postoperative cases occurring from twelve to forty-eight hours after the operation usually about twenty four it has been delayed to the second week. Epigastric pain and a feeling of distension are first complained of, and are followed by the vomiting of large quantities of fluid with very little effort but with no relief. The fluid is usually greenish-grey turbid and seldom offensive. As the disease advances, thirst becomes intolerable, the pulse rapid, respiration embarrassed, and there is great restlessness. Tetany has been observed.

On examination, great abdominal distension is evident, chiefly on the left and in the middle line. Splashing is readily obtained, and peristalsis very rarely seen. If the stomach tube is passed there is an abundant escape of gas and a large quantity of fluid is evacuated, but the stomach refills after a short time.

Diagnosis.—Early recognition is important, particularly in the postoperative cases where complications due to the anæsthetic or to the operation may be more in the surgeon s mind. Dilatation may be confused with *postanæsthetic vomiting* but this does not persist or it may appear for the first time twenty four hours after operation In the recorded cases the postanæsthetic vomiting had ceased. Early *peritonitis* following abdominal operations may be suspected, but the symptoms of the two conditions differ entirely The temporary relief following the evacuation of gas and fluid by a stomach-tube should lead to the correct diagnosis.

Prognosis.—The death rate is gradually falling as recognition of the disease and its appropriate treatment are becoming more common. In 1906 Laffer's statistics showed a mortality of [illegible] per cent. Borchgrevink s in 1913, 54 per cent. Doohn in 1918 collected 30 cases treated on correct lines with a death-rate of just below 7 per cent.

Treatment.—The patient must be placed in the prone position with a pillow beneath the pelvis and the foot of the bed raised. The stomach should be kept empty by the passage of the stomach-tube, and may be washed out. The fluid lost should be replaced by rectal salines. The posture described, first advocated by Schnitzler in 1895 seems to have been lost sight of until rediscovered by Borchgrevink in 1913 since then it has been generally recognized as the correct treatment.

Operation should never be carried out. In early cases life will

be saved by posture and lavage In those that are overlooked, no surgical treatment will be of any avail.

CHRONIC DILATATION OF THE STOMACH

These cases fall into two groups —

1 Those in which the dilatation is the result of mechanical obstruction in the region of the pylorus—obstructive.
2 Those in which the enlargement of the stomach is due to weakness of its walls—atonic dilatation.

It must always be remembered that gastric dilatation is not a disease, but a symptom.

1 Obstructive Dilatation

This may be caused (1) by lesions of the stomach itself or (2) by the action of agents external to it. Either may be malignant or simple. Thus

(1) (a) Malignant disease of the stomach or duodenum.
(b) Ulcers of the stomach or duodenum and their sequelæ simple tumours infantile hypertrophic stenosis fibrous stricture gastroptosis.

(2) (a) Malignant disease of the pancreas, gall bladder and biliary passages.
(b) Simple disease of gall bladder perigastritis abnormality of pancreas mobile kidney aneurysm

Carcinoma of the stomach frequently arises in the pyloric region and is one of the common causes of obstructive dilatation (p. 394) The onset of symptoms of interference with gastric motility in a previously healthy adult should always direct attention to this possibility Carcinoma of the duodenum is rare.

Gastric dilatation may be due to the presence of a chronic ulcer of the pyloric region of the stomach, to the contraction of scar tissue formed as the result of its healing, to perigastric adhesions, or to ulcer of the first part of the duodenum. The last-named is the most common cause. The obstruction is sometimes due to spasm of the pylorus brought about by the irritation of the ulcer but in such cases the dilatation is rarely great, and seldom in itself calls for surgical assistance, though it may be advisable to deal with the ulcer by surgical means.

Dilatation may be due to a simple polypus playing the part of a ball valve (p 390)

Infantile stenosis of the pylorus is considered on p. 329 In some cases, recovery from this condition is followed by definite symptoms of secondary dilatation of the stomach later Maylard has called attention to a group of cases of simple narrowing of the pylorus which may be congenital.

Simple fibrous stricture of the pylorus is a very unusual cause of obstructive dilatation. I have operated upon three such cases in which neither adhesion nor trace of scarring was present.

Gastroptosis may cause obstructive dilatation by producing a kink at the pylorus (p 335) The pressure of the superior mesenteric vessels on the third part of the duodenum in visceroptosis is an uncommon cause (*see* p. 327)

Malignant growths of the pancreas, gall bladder or bile-ducts may produce, among other symptoms, those of dilatation of the stomach.

Perigastric adhesions, which are due most often to chronic gastric ulcer or *less frequently* to *gall-stones* and *their* sequelæ, a *distended* gall bladder or the obstruction caused by the ulceration of a gall-stone into the duodenum or stomach, may cause symptoms of gastric dilatation.

Mobile kidney by its traction on the duodenum, is an unusual but very definite cause.

Dilatation due to pressure of a simple tumour external to the stomach is an extremely rare occurrence It has been recorded as the result of pressure by an aneurysm.

2. Atonic Dilatation

This is a condition in which, owing *to* weakness *of* the *stomach* walls, the gastric contents are not passed rapidly enough into the duodenum It is often associated with visceroptosis. Amenable to medical treatment in its early stages, it rarely becomes so extreme that the surgeon has to be called in to its aid.

Symptoms.—In the early stages the symptoms are indefinite and consist of gastric discomfort or a sense of fullness after meals. The patient at this stage often complains of eructations this is a frequent early sign of pyloric carcinoma. If at this stage gastric motility be estimated by any of the methods mentioned at p. 323, it will be *found deficient.*

In many of the simple cases there is a previous history of duodenal or gastric ulcer or of dyspepsia

Later the symptoms become characteristic food is retained in *the stomach and vomited at intervals. The vomit consists* of large quantities of sour-smelling fluid, containing perhaps fragments of food taken several days before there are associated thirst, wasting, and constipation, and the patient presents the dry harsh skin seen when the tissues are deprived of water *At this stage, too free* HCl is usually absent and the total acidity low whether the dilatation be due to simple or malignant causes.

Diarrhoea may be present. This was attributed by Boas, who called attention to the symptom in 1912 to irritation of the small intestine by the fermenting gastric contents as, however a similar condition may be present in achylia and relieved by the administration of hydrochloric acid, it is probably due to pancreatic insufficiency

Tetany may complicate gastric dilatation from any cause, but as a rule it is only seen in simple cases. Mayo Robson in 1898 pointed out the necessity for surgical treatment of the gastric dilatation when this complication has supervened Its recognition is important, as it is a serious complication, and fatal in a large proportion of cases unless treated by operation. In its fully developed form it is uncommon (McKendrick in 1907 was able to collect 63 cases) but lesser degrees are far from rare. Patients complain not infrequently of formication or numbness, or of heaviness in the limbs, followed by cramps.

Examination.—The enlarged stomach may be distinctly seen reaching in some cases as low as the pubes, and peristalsis may be noticed crossing from left to right, or it may be elicited by gently flicking the abdomen The area of stomach resonance is increased, and splashing sounds may be obtained over an area not usually occupied by the stomach at a time when it should be empty The abdomen should be carefully examined for evidences of tumour mobile kidney or gastroptosis, and the possibility of hour-glass contraction considered

X ray examination after an opaque meal reveals the loss of gastric motility and may define its cause. If this is not available, the patient should be given a glass of milk with about a dozen raisins at night and the stomach washed out in the morning any residue denotes obstruction at the pylorus.

Diagnosis.—There are two essential points to consider in the diagnosis of gastric dilatation—(1) the discovery of the dilatation (2) the discovery of its causation.

(1) Diagnosis has to be made from—

(a) *Gastroptosis* —In these patients, usually women, the history is one of vague indigestion, and could be mistaken only for that of a very early stage of gastric dilatation. It is more often confused with the early symptoms of carcinoma.

(b) *Hour-glass stomach.*—It is rarely possible to distinguish this by its *symptoms* from pyloric obstruction, which not infrequently coexists but its possible presence should always be borne in mind and its diagnosis attempted in order to prevent errors in operative treatment. X ray examination is of the greatest assistance.

(2) An attempt must be made to discover the nature of the

dilatation or its causation. Chief reliance has to be placed on a careful anamnesis. A history of preceding abdominal disease, pointing to gastric or duodenal ulcer, is obtained in many of the simple cases. The rapid onset of the symptoms of dilatation in an adult who has had no previous gastric trouble will point very strongly to malignant disease.

Examination of the stomach contents after a test meal may be of service in the differential diagnosis.

A history of biliary trouble would point to the condition being secondary to disease of the biliary passages one of difficult feeding in infancy or of lifelong dyspepsia followed by dilatation of the stomach would suggest a congenital origin.

Prognosis.—Obstructive dilatation is a disease of grave prognosis unless treated surgically but if treated on modern surgical lines the death rate is small and the ultimate recovery in the majority of cases perfect. In cases in which tetany has developed, the death-rate under medical treatment has been from 70 to 90 per cent. Under surgical treatment the prognosis even of the cases with tetany has been greatly improved thus, McKendrick has collected 24 such cases with only 3 deaths.

Treatment of chronic dilatation.—*Obstructive* dilatation of the stomach should be surgically treated It is useless attempting to cure the condition by lavage.

The exact operation necessary will depend on the causation. The choice lies in the majority of cases between gastro-jejunostomy and gastro-duodenostomy (Finney's method). Operations such as pylorodiosis or pyloroplasty are followed by relapse in many cases, and should not be considered

In cases in which the dilatation is due to mobility of the right kidney the surgeon should fix this organ before resorting to further treatment. In cases due to disease of the gall bladder, the removal of gall stones and division of adhesions may suffice to cure.

If the obstruction is due to congenital narrowing of the pylorus or to the fibrous variety of stricture, gastro-duodenostomy by Finney's method is the best operation, restoring the condition of the parts as nearly as possible to normal. When, owing to the presence of active ulceration or of many adhesions around the pylorus, this is inadmissible posterior no-loop gastro-jejunostomy should be performed.

The result of surgical treatment on these lines is most gratifying the death rate in large numbers of cases is less than 2 per cent.

Advanced cases of *atonic* dilatation may in rare instances need surgical treatment, but this must only be carried out after the failure of prolonged medical treatment, rest in bed and lavage. As first

pointed out by Mikulicz, and again by Paul and the present writer gastro-jejunostomy in this condition is frequently followed by the establishment of a vicious circle.

In these cases a mechanical factor is added namely kinking at the pylorus. Finney's operation, followed by medical treatment, will give relief, and should be carried out.

Attempts have been made to treat the condition by folding the wall of the stomach so as to make it smaller (gastroplication) This is useless, for the size of the stomach matters not at all the patient is suffering from weakness of the stomach wall with or without obstruction and in neither case can good result.

INJURIES

The stomach or duodenum may be injured by violence applied from without, in abdominal contusions and wounds or from within as the result of the passage of instruments, over-distension or the action of swallowed corrosive fluids or foreign bodies.

RUPTURE OF THE STOMACH

Uncomplicated rupture of the stomach is an accident of extreme rarity The cases may be divided into two groups, the "spontaneous" and the traumatic. In both the rupture may be complete involving all the layers of the stomach wall, or incomplete the latter can be subdivided into those involving the serous coat only; those involving serous and muscular coats—the interstitial, usually due to external injuries; and those causing rupture of mucosa, generally the result of internal violence

Spontaneous Rupture of the Stomach

This heading should cover only cases of rupture of a presumably healthy organ, occurring apart from external violence. It has been customary to include ruptures due to lavage and distension with air but these fall more appropriately into the next group. It is an exceedingly rare condition, for not more than 10 cases have been recorded, all of which terminated fatally The rupture is usually at the lesser curvature and generally occurs as the result of spontaneous over-distension; in at least 2 of the cases it followed vomiting.

It is impossible to diagnose more than the occurrence of a perforative lesion in the upper abdomen. Operation should be undertaken at once and the rent in the stomach closed.

Traumatic Rupture of the Stomach

These fall into two groups, due to—(1) direct violence, (2) indirect violence.

1 *Direct Violence*

The violence may affect the stomach (*a*) from without, as in abdominal contusions, or (*b*) from within, the result of over-distension or of the passage of instruments.

(a) *Complete* rupture of the stomach from *external violence* is rare; rupture of the stomach apart from injury to other viscera is rarer still. Between *the years 1899 and 1919 11 cases of ruptured stomach were admitted to the* London Hospital—in 3 only was it the sole viscus injured, and in 2 cases ribs were fractured. Gastric ruptures usually occur in "run-over" accidents, the wheel passing over the epigastric and umbilical regions. Another and rarer cause is localized injury to the epigastric region, such as by a kick from a horse; in this variety the stomach is more likely to suffer alone. *In both it is unlikely to be injured unless full.*

Ruptures from external violence are usually situated in the region of the greater curvature.

Diagnosis.—It is unusual for this to be made before operation. It is unwise to make any attempt at definite diagnosis by such means as inflation with air. The important point is to decide that exploration is necessary.

Treatment.—After any abdominal contusion the patient should be placed in bed and carefully watched, the pulse and temperature being taken hourly. No morphia should be given until the question of operation has been settled, and then only if the patient has to be moved to hospital or nursing home.

If the abdomen is rigid, or contains free fluid or gas, operation should be immediate. If the signs are inconclusive, operation should be undertaken as soon as it is seen that the patient is getting worse or not rallying from the shock.

The rent should be sutured and extravasated fluid carefully sponged away. The employment of drainage will depend upon the extent of peritoneal soiling or peritonitis; if the latter is present, the usual treatment must be adopted (p. 371).

Prognosis.—This is extremely grave; all the cases treated at the London Hospital have died. According to Deaver and Ashurst, only four operations for traumatic rupture of the stomach have been recorded, and all resulted in death.

Partial rupture from external violence.—In these cases the serous, muscular or mucous coats of the stomach, alone or together are torn. In some cases a hæmatoma develops in the gastric wall and may be absorbed, or form a cyst which may become infected and result in an interstitial abscess. This may rupture into the stomach, the pus be vomited, and recovery ensue; or into the peritoneal cavity; or after adhesions have formed externally may discharge, producing a gastric fistula.

The gradual formation of a swelling in the epigastric region following an injury should lead to the suspicion of a partial rupture of stomach and to exploration. Pseudo-pancreatic cyst (Jordan Lloyd) must be considered in diagnosis.

An injury of the mucous membrane may lead to the formation of the so-called "traumatic ulcer" of the stomach, characterized by the usual symptoms, but as a rule healing rapidly. In a few cases such "ulcers" become chronic, and have given rise to perforation, hæmatemesis, hour-glass stomach or gastric dilatation. It must be emphasized that this is a condition of the greatest rarity. Treatment is that of non-traumatic ulcer (p. 361).

(b) Rupture, *complete or partial*, may follow *distension* of the stomach by fluid used for lavage, or gas used in distending the stomach for diagnostic purposes. These cases are rare. One example only has occurred at the

London Hospital in the last twenty years, in a patient with dilated stomach the result of pyloric carcinoma. During lavage there was a sudden onset of pain and collapse. At operation five hours later a rupture at the lesser curvature was found. The patient died sixteen hours after operation.

Ruptures from over-distension occur most frequently at the lesser cur vature very occasionally at the site of an ulcer simple or malignant. Ruptures may also be produced by *the passage of instruments* such as the gastroscope, for exploratory purposes.

If sudden pain and collapse follow the passage of a stomach-tube or diagnostic instrument, thus raising the suspicion that this accident has occurred, immediate operation must be undertaken.

2 *Indirect Violence*

Cases have been recorded in which gastric hæmorrhage has followed falls on the back or the buttocks, or the lifting of heavy weights. It is just possible that lesions of the mucous membrane may account for these cases; from their nature they do not lead to post-mortem examination leeding after indirect injury comes, in most cases, from œsophageal varices ne to cirrhosis of the liver All the cases of this nature that have come under ny observation, in which there was no history of previous gastric trouble ppeared to be due to this cause, but I have known severe hæmatemesis follow indirect violence due both to falls and to strains, in patients with chronic gastric ulcer

Injury may be the exciting cause leading to the perforation of a gastric or duodenal ulcer; several cases have come under my care in which per foration occurred at the time the patient was straining to lift a heavy weight (see p. 367). The onset of sudden pain and acute abdominal symptoms in circumstances such as these should lead to a suspicion of perforation and to immediate operation.

RUPTURE OF THE DUODENUM

While rupture of the stomach is extremely rare, rupture of the duodenum is still rarer

Between the years 1899 and 1919 only 5 cases of ruptured duodenum were admitted to the London Hospital. In 2 the stomach also was ruptured.

Berry and Giuseppi found records of only 132 cases of traumatic intes tinal rupture in ten London hospitals from 1893–1907; the duodenum was affected in 23 and the duodeno-jejunal flexure in 3. Meerwein, in describing (1907) a case under his care, collected all the published cases of traumatic rupture of duodenum, 64 in number These include only 2 of those collected by Berry and Giuseppi.

The transverse portion of the duodenum usually suffers, the rent being most often at right angles to the long axis of the gut. As in ruptures of the stomach, the lesion may be complete or incomplete; the latter is rare, but Berry records an instance in a boy of 15 in whom "a clot of blood as large as a hen's egg lay between the peritoneal and the muscular coats and com pletely blocked the second part of the duodenum." The rupture may be retroperitoneal. This occurred in 4 out of the 23 cases collected by Berry and Giuseppi.

As in other parts of the alimentary canal, partial rupture may be re covered from and lead to obstructive symptoms later Meerwein records 2 cases in which spontaneous recovery occurred, but biliary obstruction in one and dilated stomach in the other necessitated operation.

Diagnosis.—It will be impossible, before operation, to make a definite diagnosis of the portion of the gut injured. Rupture of the duodenum should be suspected in all cases of injury to the upper abdomen. Retroperitoneal injury should be suspected when symptoms of sepsis follow an injury to the upper abdomen.

Treatment.—The general rules which govern operation after abdominal contusions are to be followed. Rupture of the duodenum should always be borne in mind, and its whole extent carefully examined. It was overlooked at operation in 7 of Berry and Giuseppi's cases, and in 7 of the 29 cases recorded by Meerwein in which operation was performed.

If the rent involves, as is usual, the anterior wall of the duodenum only it should be closed after paring the edges to remove damaged tissue. If the rent is complete, gastro-jejunostomy will be the best course to pursue after closure of both ends of the gut. End to-end suture of the second or third parts of the duodenum is unlikely to be successful on account of the absence of peritoneum from its posterior surface.

Prognosis.—This is extremely grave. Complete rupture, unless treated by operation, is inevitably fatal. Death followed in all the cases recorded by Berry and Giuseppi, in those admitted to the London Hospital, and in all but 2 of the 29 recorded by Meerwein, in which operation was performed.

WOUNDS OF THE STOMACH

The stomach may be injured in penetrating abdominal wounds the result of stabs with sharp implements or of gunshots.

STAB WOUNDS

Wounds in the stomach are rare in civil life in this country No case has been treated at the London Hospital between 1899 and the time of writing Among 75 cases of wounds of the stomach collected by Siegel, 4 were the result of stabs. Even when the stomach is wounded, the case is often complicated by simultaneous injury to other organs.

The stomach may be injured alone in stabs in the epigastric region, and it is important to remember that stab wounds of the lower chest are not infrequently complicated by injury to the stomach.

Symptoms.—These will depend to a certain extent upon the contents of the stomach at the time of the infliction of the injury and the size of the wound. Sudden leakage of gastric contents into the peritoneal cavity will be followed by the usual signs accompanying perforation of an abdominal viscus. In a few cases the escape of gastric contents from the wound their presence upon the instrument inflicting the injury or hæmatemesis may render the diagnosis certain But it must be remembered that the stomach may be wounded and no symptoms be present at an early stage, also that hæmatemesis may occur from bruising or laceration of the mucous membrane of the stomach without penetration.

Treatment.—If it is certain from the symptoms that the wound is a penetrating one it should be opened up and a careful

examination made, remembering, if a wound is found on the anterior surface of the stomach, that the posterior surface may have been simultaneously damaged. The wound in the stomach should be closed Any extravasated contents should be gently wiped away If there is extensive soiling of the peritoneum a tube should be put in above the pubes if general peritonitis is present, the appropriate treatment should be adopted

Prognosis.—If operation is carried out within the first twenty four hours the prognosis is good recovery took place in 8 of the 9 recorded cases.

GUNSHOT WOUNDS

It is comparatively rare for the stomach to be injured alone. Thus, out of 965 cases of penetrating abdominal wounds recorded by Sir Cuthbert Wallace, the stomach was perforated in 82 and in 55 it was the only viscus injured.

Symptoms.—Vomiting is more frequent than after similar injury of any other organ. As pointed out by T R. Elliot and H Henry ulceration, secondary hæmorrhage, and perforation are later complications in both sutured wounds and contusions.

Treatment.—The abdomen should be opened through a para median incision and the stomach carefully examined After suture of a wound on the anterior surface the posterior surface should be exposed by making a wide opening in the gastro-colic omentum Two perforations were present in 15 out of the 55 cases in which the stomach was injured alone (Wallace) In every case search should be made for injury to other organs. If the diaphragm be simultaneously wounded, the pleural cavity should be drained. It is only in cases in which the fact of perforation is doubtful that the bullet wound itself should come into the incision.

Prognosis.—The mortality in the cases uncomplicated by wounds of other organs was 52 7 per cent.

FOREIGN BODIES IN THE STOMACH AND DUODENUM

The patients are usually children, hysterical girls, insane people, and jugglers. Occasionally a foreign body such as a tooth plate or a piece of bone is swallowed by sane adults.

The majority of foreign bodies swallowed pass out of the stomach and are discharged naturally a few days later A few depending on their size and shape, may lodge in the stomach, or in rare cases in the duodenum The foreign body may remain in the stomach for years without giving rise to symptoms, or it may perforate acutely or cause ulceration subacute perforation, perigastric abscess, or gastric fistula.

In children and the insane no history may be obtainable, and the onset of vomiting and pain causes attention to be directed to the stomach. The finding of a foreign body in the vomit may lead to a diagnosis of the cause of the symptoms.

The foreign body may be composed of hair the so-called hair ball. In these cases the patient or friends may fail to connect the habit of hair biting with the abdominal signs and the surgeon may omit to consider this possibility but in all obscure abdominal tumours in women it should be remembered. These tumours are rarely found

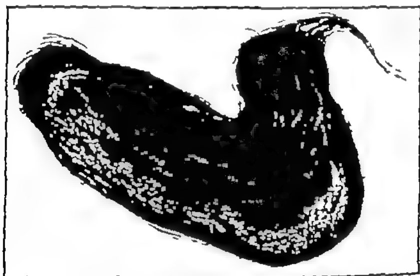


Fig 372.—Hair ball removed from the stomach. (*Rigby's case*)

(*London Hospital Museum*)

in men, and are uncommon in the insane Up to 1921 108 cases had been recorded (Ivor J Davies)

The quantity of hair present varies in one case operated upon successfully by Swain, it weighed 5 lb. 3 oz. The mass can usually be felt through the abdominal wall. When small it occupies the pyloric region, but as it increases in size it forms a cast of the stomach which may in rare cases extend into the œsophagus or into the duodenum (Fig. 373). Symptoms may be absent, and the abdominal tumour discovered by accident. As a rule, however pain and vomiting are present after food. The tongue is foul, and the patient is usually anæmic.

The radiographic appearance after a bismuth meal is typical. It was first described in 1913 by Thurston Holland, and Barclay in the same year made the first preoperative diagnosis by this means. (Plate 92.)



Fig. 1.—The light area in the dark mass is the hair-ball.



Fig. 2.—Shows upper end of hair-ball pushed up into air-space.



Fig. 3.—Air-space distended with CO_2 showing upper extremity of hair-ball.

Hair-ball in stomach (A. E. Barclay.)

PLATE 92.

INJURY FROM CAUSTICS

Fenwick states that the average duration of the disease in these cases is about fifteen years. All end fatally unless operated upon from ulceration and perforation of the stomach and its sequelæ or from exhaustion

Concretions formed of vegetable fibres are occasionally found usually in patients who have chewed roots which have reputed medicinal properties and gastroliths in patients who have drunk varnish in their craving for alcoholic liquor—the gastrolith is usually composed of shellac according to Fenwick, only 4 cases have been recorded.

Treatment.—This will depend on the form consistence, and size of the article swallowed Rounded objects, coins, buttons etc usually give rise to no trouble tooth-plates and pencils rarely pass. If it is thought that the foreign body is likely to pass, a diet of porridge or mashed potatoes should be given but no purgatives. The patient should be X rayed and the exact location of the foreign body determined. It must be remembered that its weight may displace the stomach, and it may be necessary to use X rays after an opaque meal. If the foreign body is giving rise to no symptoms, no hurry is necessary

If natural discharge is impossible, from the size shape or number of foreign bodies or if symptoms are produced immediate operation should be performed.

In most cases it will be necessary to open the stomach The incision should be transverse to its long axis. It may be possible to remove the foreign body after the abdomen has been opened by means of forceps such as Brüning's or Bilton Pollard's

If the foreign body is in the duodenum, an attempt should be made to push it back into the stomach and extract it from there only if this fails should the opening be made in the duodenum

Prognosis.—This is extremely good Out of 20 cases published since 1900, and collected by Deaver and Ashurst, in which operation was performed there was only 1 death.

INJURY BY CAUSTIC FLUIDS

Mineral acids and alkalis swallowed by accident or with suicidal intent, cause serious injury to the stomach. In many of these cases surgical treatment is sooner or later necessary to remedy the resulting contraction-deformities of the stomach [1]

[1] Cases of caustic-swallowing admitted to the London Hospital in the decennium 1899-1908 totalled 189. Deaths within a few days numbered 25—of these 12 died of gastric perforation (11 HCl, 1 carbolic); 8 cases required operations for mechanical disabilities within a few months, viz. 4 for pyloric stenosis, 3 for œsophageal stricture, and 1 for both. There is no doubt that the figures, 8 out of 164, greatly understate the frequency of late surgical complications.

The cardiac end and pyloric portion of the stomach suffer most, and in some cases the latter is alone injured.

The stomach is markedly affected if a large quantity of corrosive fluid has been swallowed when the viscus is empty Vomiting is incessant, and the vomit contains blood and is often foul-smelling. In two cases the smell was so offensive that I was asked to see the patients as examples of gastro-colic fistulæ. Thirst is severe, restlessness is extreme, and many patients succumb in the early stages to lung complications.

Perforation may take place. This is stated to occur most frequently after alkalis, an unusual form of corrosive poisoning in London Of the 12 cases of perforation recorded in the footnote on p 351 11 occurred after hydrochloric acid.

Treatment.—After the appropriate antidote has been given, rectal feeding must be employed and no food given by the mouth. If there are ulcerated surfaces in the mouth and pharynx, these should be kept clean by mild antiseptic solutions.

After a few days, feeding should be cautiously begun. Small quantities of albumin water should be first tried, and, if this causes no pain or vomiting, Benger's or Allenburys food may be given. If at the end of about a week it is found that the introduction of food causes pain and vomiting, operation should be performed without delay In most cases jejunostomy will be necessary but if the lesion proves to be confined to the pyloric portion of the stomach, gastro-jejunostomy should be performed.

In less severe cases it not infrequently happens that after five or six weeks signs of cardiac or pyloric obstruction develop The appropriate operation should be done—in the former case gastrostomy in the latter gastro-jejunostomy It sometimes happens that hour-glass stomach develops. This should be treated on the usual lines (p. 338). Gastro-jejunostomy will suffice in most cases, as the pyloric pouch is small.

GASTRIC AND DUODENAL ULCERS

The stomach, and the duodenum as far as the entrance of the common bile-duct are frequently the seat of ulcers, which resemble one another in their anatomical features, and are probably caused in a similar manner it is customary to classify them as acute and chronic.

GASTRIC ULCER

Etiology.—Gastric ulcer is a common condition. Brinton stated that a " peptic ulcer open or healed, was present in 5 per cent. of all autopsies these figures were confirmed by Welch and Green

hough and Joslin. C. H. Mayo, however is of opinion that peptic ulcer is met with in but a fraction of 1 per cent. of the findings of general autopsies. But its frequency varies in different parts of the world. It is more common in northern climates, and in England than on the Continent.

There has been an undoubted increase in the number of patients admitted to hospital with a diagnosis of gastric ulcer confirmed at operation or post mortem. To take figures about which there can be no dispute—the cases of perforation. In the ten years 1899–1908, 136 were admitted to the London Hospital 54 of whom were men. In the years 1910 to 1919 the number was 235 of whom 141 were men.

It was at one time customary to consider gastric ulcer essentially a disease of women. With the development of gastric surgery our ideas have undergone a change. In many cases diagnosed clinically as gastric ulcer particularly in young women, no ulcer is found, and in this class of case often associated with hæmatemesis, the breach of surface of the mucous membrane is so small that it may be overlooked and sometimes cannot be discovered even post mortem.

Acute ulcers undoubtedly give rise to symptoms more often in women, and this type of disease is probably commoner in them. It is a difficult subject, as few uncomplicated cases are fatal and the existence of the ulcer cannot be confirmed at operation, unless it has perforated, and it may be overlooked even if the stomach is opened. Again symptoms resembling those produced by acute ulcers may be due to disease in other organs. It is only when perforation or fatal hæmorrhage has occurred that a certain diagnosis can be made. Of 87 cases of perforated *acute* ulcer operated on at the London Hospital between the years 1909 and 1919 47 were in women. This is a high percentage when we remember the much greater frequency of perforated ulcer in men.

On the other hand chronic gastric ulcer is undoubtedly more frequently met with in men. Thus, in 476 cases of chronic ulcer operated on by the writer (excluding acute perforation) to June 1st, 1921 301 were males. It is probable that the exact rate varies in different countries. C. H. Mayo gives the figures for the Mayo Clinic as three to one Berkeley Moynihan as two to one.

With regard to age, various statements have been made from time to time. The old figures given by Mayo Robson, that 75 per cent. of the cases in women and only 25 per cent. of those in men are found before the age of 20 agreed with those of the London Hospital as given in the first edition of this work. Since then we have appreciated the difficulty of diagnosis apart from operation, and do not consider that statistics so definite as these can be given

Our knowledge, however, tends to show that the disease occurs earlier in women and the series of chronic cases subjected to operation shows that the time of onset of symptoms and date of operation are later in men than in women. To give an example In 169 consecutive cases of perforated ulcer in women operated on at the London Hospital 92 of the patients were between the ages of 15 and 25, in 193 cases in men, only 31 occurred during this period of life.

The characteristic of acute ulcer of the stomach is its tendency to heal. Not only has its causation to be explained, but its relationship to chronic ulcer and the reason of the transformation of one into the other in certain cases.

Various terms have been applied to acute ulcer—erosion, exulceratio simplex, follicular ulcer hæmorrhagic erosion. "Hæmorrhagic erosion" is a loss of substance due to hæmorrhage into the mucous membrane and although not an ulcer may result in one the other terms are synonymous with acute ulcer

Acute ulcer is generally multiple, and 60 per cent of the cases occur between the ages of 15 and 25 Chronic ulcer occurs later in life, and is usually solitary

Experimentally produced ulcers tend to heal rapidly and it is extremely difficult to delay healing The same applies to "clamp ulcers in man (ulcers produced by the pressure of clamps during operation) If death occurs from some complication, such as pneumonia, these ulcers are sometimes found but always, if sufficient time has elapsed, in the healing stage.

All evidence goes to show that ulcers are in some way due to the digestive process, i.e. are peptic Various theories have been brought forward. A theory which has been resuscitated from time to time was first propounded by Virchow that ulcers are due to vascular thrombosis following embolism such *causation* must be very rare. Recent work (Reeves) however has shown that the arteries supplying the lesser curvature of the stomach and the first part of the duodenum run a more tortuous course and anastomose less freely than elsewhere, which would render them more liable to thrombosis. This may have some connexion with the *localisation* of ulcers. *Nerve* disturbance has been suggested, but there is no evidence of this beyond the fact that ulcers can be produced by interference with the vagi. Proof of infective origin is more convincing As long ago as 1860 Cohen injected pus into the circulation and produced acute gastric ulcers. In 1893 Enriquez and Hallion showed that the injection of toxins (diphtheria toxin was used) brought about the same result. In 1916 Rosenow found gastric and duodenal ulcers in 60 per cent. of animals into whose venous circulation he injected strepto-

cocci isolated from similarly placed ulcers in man they tended to become chronic and to perforate.

Our knowledge of the causation of ulcers has been largely advanced by the experimental work of Bolton, who has shown that gastric ulcers are due to the action of the gastric juice upon devitalized gastric mucous membrane. By injecting into guinea pigs gastrotoxic serum prepared by injecting the gastric cells of the guinea pig into the rabbit, areas of necrosis and punched-out ulcers were produced The formation of these could be prevented by neutralizing the gastric juice with 20 c.c. of a 1 per-cent. solution of bicarbonate of soda. Hyperacidity of the gastric juice alone would not produce ulcers, but any excess of hydrochloric acid increased the lesion produced by the injection of gastrotoxic serum. The injection of hepatotoxin, enterotoxin, and hæmolysin also produced in the mucous membrane of the stomach necrotic patches indistinguishable from those produced by gastrotoxin

Further experimental work on the same subject was published in 1915 Six injections of the emulsion of a monkey's stomach were given to a goat at intervals of ten to fourteen days. The goat's serum (5–10 c c) was injected under the gastric wall of a monkey and a slough was produced in four or five days, followed by a punched out ulcer, which took three weeks to heal. That the ulceration was due to a specific property of the serum was proved by using normal serum in a control monkey no ulcer was produced Healing could be delayed by increasing the acidity of the gastric juice the HCl acting on the granulating floor healing was still further delayed by pyloric stenosis. Thus an experimentally produced acute ulcer could be prevented from healing and converted into a chronic ulcer by increasing the acidity of the gastric juice and inducing pyloric stenosis. His experiments also showed that extension of an ulcer is due to persistence of the original cause—some fresh infection damaging the mucous membrane

Clinical evidence agrees with these conclusions. The higher acidity of the gastric juice in men would explain the greater frequency of chronic ulcers in the male sex An infective origin is indicated by the prevalence of acute ulcers in certain diseases—puerperal infections, tuberculosis, Bright's disease any septic disease or suppuration, burns (the well known Curling's ulcer of the duodenum) pyorrhœa, and appendicitis. In 26 cases of acute ulcers in patients dying from other causes, I found that 20 complicated surgical lesions, and more than half of these were abdominal. The figures are Suppurative appendicitis, 12 pylephlebitis, gangrene of the foot (Fig 374), intestinal obstruction, acute disease of gall bladder 2 each In cases of gastric or duodenal ulcer a history of an attack of

appendicitis is common, and on operation a diseased appendix is frequently found. Suggestive of acute ulceration is the hæmatemesis occasionally seen in appendicitis and cholecystitis.

The healing of chronic gastric and duodenal ulcer after gastrojejunostomy confirms the opinion formed on experimental grounds that delayed healing is the result of gastric stasis and hyperacidity. Rapid emptying of the stomach is the rule, and the operation should abolish free HCl in the gastric contents and greatly diminish gastric acidity. Clinical evidence, therefore, strongly confirms the experimental that acute ulcers are the result of infection, and that their healing may be retarded or prevented by hyperacidity and gastric stasis.

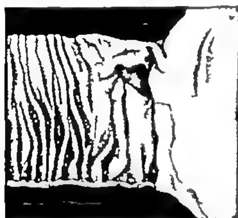


Fig. 374.—Acute duodenal ulcer found post mortem in a child of 3½ who died of gangrene of the leg following a crush.

The investigations of Hurst (Figs. 360–2, p. 315) throw light on the question of localization of ulcers, and explain why in one patient it is gastric, in another duodenal. He has found two types of stomach—hypertonic and hypotonic. The hypertonic empties rapidly and is associated with increased acidity of gastric juice. It is more common in men, and with this type the ulcer is found in the duodenum. The hypotonic stomach empties slowly and is associated with ulcer on the lesser curvature.

Acute gastric ulcers are due to the autodigestion of areas of gastric mucous membrane, the resistance of which has been lowered as the result of toxic products acting directly on the gastric cells or giving rise to a swelling and erosion of lymphoid follicles. Chronic appendicitis is probably a frequent source of the septic infection. The great increase in the number of cases of gastric and duodenal ulcer is probably connected with the rise in incidence of this disease. The lowered resistance of the gastric mucous membrane may possibly in some cases be produced by obstruction of small vessels either by emboli or by thrombosis.

The reason for the *chronicity* of ulcers is to be sought in hyperacidity and pyloric spasm. The cause of their greater frequency in males may be related to the greater prevalence of disease of the appendix in the male sex, and also to the fact that gastric acidity is higher than in women. Oral sepsis is present in most cases, and

may be the causative infection. Barclay has shown that it is a potent cause of spasmodic contraction of the stomach.

Site.—Ulcers of the stomach are usually situated on the lesser curvature towards the pylorus, and involve more often the posterior than the anterior wall. Those which are situated on the lesser curvature not infrequently involve both walls and constitute the so-called "saddle" ulcers (Figs. 375, 376). The acute ulcers which perforate are most often situated on the anterior wall (Fig 377)



Fig 375 — Saddle-shaped ulcer of lesser curvature, with pancreas exposed on the floor of its posterior portion.

(*London Hospital Pathological Institute*)

Morbid anatomy —Acute ulcers are usually situated on or near the lesser curvature. They vary in shape from tiny clefts to rounded punched out ulcers. These latter are conical in shape, the deeper layers being affected to a less extent than the mucous membrane. The floor usually formed of the muscular coat, is not covered with granulations, and post mortem no peritoneal involvement is found. Microscopical examination reveals necrosis without any special infiltration with small lymphocyte-like cells or granulation tissue cells, and the mucous membrane is usually healthy right up to the margin of the ulcer

In cases of acute ulcer leading to perforation, as seen at operation the surrounding stomach wall may be œdematous, but this condition is absent post mortem, and is not marked if operation is performed within a short time after the perforation.

The initial lesion may be one of three—(*a*) necrosis of the

mucous membrane, (b) inflammation of lymphoid follicles, (c) hæmorrhage.

Lymphoid follicles are grouped along the lesser curvature, in the pyloric region and the first inch of the duodenum. C. H. Miller states that they tend to disappear between the ages of 45-50. Lansdown and Williamson pointed out that similar lymphoid masses are found in the appendix, and suggest that when appendicitis and ulcer coexist they may have a common cause.

The shape of a chronic ulcer varies. There are two principal types, the round (Fig 378) and the saddle-shaped (Fig. 375) The former is found in its most typical form on the posterior surface of the stomach, and in small ulcers on the lesser curvature. The latter is found on the lesser curvature, and when the stomach is opened out, as in Fig. 375, is roughly oval in shape. The round ulcer tends to penetrate deeply and involve neighbouring organs. At the edge of a chronic ulcer more superficial ulceration is not infrequently met with representing recent ulceration. The floor is usually covered with scattered granulations. Satellite acute ulcers are sometimes present. The peritoneum covering it is thickened, and adhesions are often met with. When seen during life the peritoneum is rough and often red-speckled, and there is frequently a "sentinel" enlarged lymphatic gland between the layers of the neighbouring omentum. Adhesions to surrounding organs may take place, and in this way with a continuance of the ulcerative process producing destruction of the stomach wall, the floor of the ulcer may be formed of pancreas or of liver Blood vessels may be laid bare, and the consequent weakening of their coats may lead to the formation of an aneurysm and to fatal hæmatemesis (Fig 379)

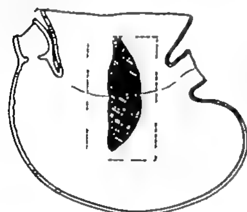


Fig 376.—Diagram showing the situation of the ulcer in Fig 375

Symptoms.—The most constant symptom is pain, and the striking feature in connexion with the symptoms of chronic gastric and chronic duodenal ulcers is their remission. In both, attacks of pain after food lasting two or three weeks, intermit with periods of digestive tranquillity In the early stages these intervals are much longer than the periods in which the patient suffers discomfort. It is only when complications have arisen, such as chronic perforation

and erosion of neighbouring organs, particularly the pancreas, or the formation of a stricture, that this periodic relation is reversed

At one time it was stated that 20 per cent of ulcers are latent (Savariaud) Few ulcers are really latent but in people over 50 ulcers may be found on the posterior surface of the stomach or duodenum that from their appearance seem to be older than the symptoms

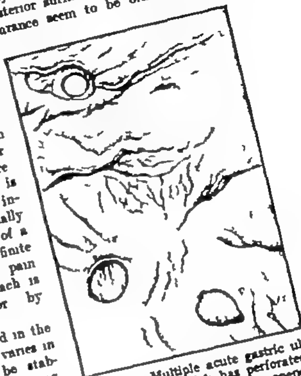


Fig 377 —Multiple acute gastric ulcers, one of which has perforated. The stomach has been opened along its greater curvature. The ulcer which has perforated is on the anterior surface and shows the typical characteristics of an acute ulcer

(*London Hospital Pathological Institute*)

The "classical" symptoms were always given as pain vomiting, and hæmatemesis. The last two are often absent and are more often present in conditions other than ulcer Pain is the prominent feature and is rarely absent. It is closely associated with the ingestion of food it usually appears within an hour of a meal, there is always a definite latent period, and the pain persists until the stomach is emptied naturally or by vomiting

The pain is situated in the epigastric region, and varies in character It may be stabbing, or burning, or cramping or may double the patient up sometimes suggesting biliary colic In ulcers on the posterior surface and lesser curvature the pain is usually to the left of the middle line the nearer to the cardiac end of the stomach the lesion is situated the higher in the epigastric region is the site of the pain. This fact was first pointed out by Brinton, and stress was laid on it by Sir James Mackenzie In pyloric ulcer the pain tends to appear later and to be to the right of the middle line In some cases of chronic ulcer involving the pancreas the pain appears late and may be definitely relieved by taking food it may wake the patient at night so mimicking though not accurately the symptoms of chronic duodenal ulcer The pain may be referred to the left dorsal region, and not

mucous membrane, (b) inflammation of lymphoid follicles, (c) hæmorrhage.

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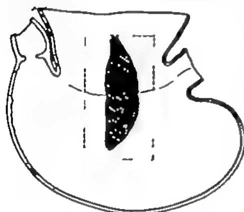


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must, however be remembered that profuse hæmatemesis is more often met with in diseases other than chronic ulcer

Anæmia may be present in patients with acute and also with longstanding chronic ulcers in the latter it is often a striking feature.

Occasionally a definite **tumour** is felt, resembling that discovered in carcinoma of the stomach There is no *certain* means of differentiation neither X ray examination after an opaque meal nor the examination of the stomach contents after a test meal may give any help (see p 401)

Complications.—The following are the important complications (1) Perforation acute and chronic (p. 367) (2) hæmatemesis (3) pyloric stenosis (see p 341) (4) hour-glass stomach (see p. 336) (5) gastric fistula, internal and external (see p. 415) (6) gastric carcinoma (see p. 397)

Diagnosis.—This can only be made with accuracy if direct evidence (see p. 331) can be obtained from X ray examination after an opaque meal In considering the causation of suspicious symptoms, it must be remembered that disease in any part of the body may give rise to dyspepsia, as well as affections of other abdominal organs. Pain which is frequently on the left side may lead to suspicion of *renal disease* and, similarly renal calculus may cause symptoms suggestive of ulcer but this is less common.

If a patient presents the symptoms of epigastric pain originating a short time after food relieved by vomiting, and especially if he has hæmatemesis, he is suffering from a definite lesion of the mucous membrane of the stomach, but not necessarily one that can be demonstrated as an ulcer It has been shown by clinical observations and by the experiments of Bolton that lesions of the mucous membrane of the stomach occur in many diseases and may present all the symptoms of ulcer

There is a group of cases in which hæmatemesis is a prominent symptom, called by Lord Dawson *hæmorrhagic gastralgia* identical with that described by Hale-White under the term *gastrostaxis* These cases are often, though not necessarily associated with anæmia although uncommon after 40 and most frequently met with in young women, they may occur at any age and in the male sex. In some examined at operation and post mortem, no ulcer has been found. But in many cases " erosions have been present, seen during life although escaping observation post mortem unless the stomach is examined with a lens. Hæmatemesis may be the first symptom (see p 333)

When typical symptoms are present in men, in whom chronic gastric ulcer is more common, few mistakes arise but in women

infrequently in an ulcer of the anterior surface, to the left shoulder. It is often associated with tenderness, superficial and deep (see p. 320).

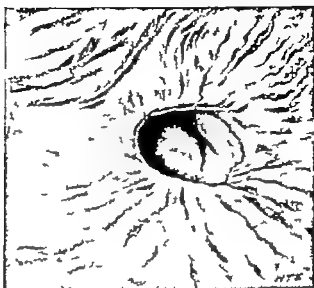


Fig 378.—Chronic round gastric ulcer

In a large proportion of cases of chronic ulcer free HCl and the total acidity of the gastric contents are little altered from the normal but cases occur in which free HCl is diminished or absent and occasionally when the ulcer is active there may be hyperchlorhydria.

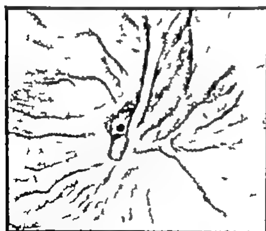


Fig 379 —Portion of posterior wall of stomach, showing a chronic ulcer which had eroded the splenic artery

(*London Hospital Museum.*)

Vomiting is usual at some time during the course of the disease, but is rarely one of its prominent features. Its occurrence relieves the pain experienced from the ingestion of food. The emesis may be self induced, but this is more often the case when the ulcer is duodenal.

Bleeding into the stomach probably takes place in the majority of cases of gastric ulcer it

may have been no local symptoms pointing to appendicular disease. The symptoms may mimic either gastric or duodenal ulcer but with care may in most cases be diagnosed from them. The chief complaint is of pain situated in the epigastrium, occurring in attacks, sometimes due to exercise. Between the attacks there is often continual gastric discomfort. In other cases pain is complained of day after day without real periods of relief. The pain may come on shortly after food, or be delayed, and this capricious time element is important in the diagnosis. Vomiting is rarely present, but nausea is frequent.

During an attack, slight rigidity and deep tenderness may be present in the right iliac fossa, and the temperature may be a little raised. Between the attacks, tenderness may be absent. Hæmatemesis may occur.

The symptoms have been attributed by W. J. Mayo and by Berkeley Moynihan to pyloric spasm, by Soltau Fenwick and Paterson to hypersecretion of gastric juice. I believe the former to be the usual explanation. In a large number of the cases of "appendix dyspepsia" that have come under my care free HCl has been absent and the total acidity low. It must be remembered, however, that disease of the appendix may give rise to "erosions" of the mucous membrane of the stomach, which may go on to chronic ulceration.

Careful attention to the history, confinement to bed, and examination during the attack should in most cases enable the surgeon to make the diagnosis.

Carcinoma.—The differential diagnosis between carcinoma and simple chronic ulcer is discussed elsewhere (p. 401). It must first be remembered that in those cases in which carcinoma is directly implanted on chronic ulcer there may be no symptoms or signs that the latter has become malignant: the history of chronic ulcer extending over years is obtained, with remissions of almost complete health, but usually there is a change in the symptoms—the attack does not pass off in the usual way, or the pain becomes constant. The diagnosis of malignancy may only be made at operation, or by the microscopical examination of the specimen removed. The history of primary carcinoma is usually insidious, and includes the onset of gastric symptoms at middle age, a distaste for food, a gnawing pain, often not definitely relieved when the stomach is empty, and a steady decline in health. The onset of symptoms of pyloric stenosis without previous history of gastric trouble usually means carcinoma.

Prognosis.—All modern observers are agreed that a chronic gastric ulcer carries with it a grave prognosis. It is well known that relapse is common after medical treatment and apparent cure

diagnosis may be impossible. It must always be remembered that disease of the gall bladder of the colon or the appendix, may cause dyspepsia. The stomach symptoms associated with tabes, and with uræmia and diseases of the bladder and urethra, should be remembered, for gastro-jejunostomy has been performed on more than one patient suffering from these complaints. A careful study of the patient will ensure diagnosis of the last three groups, but no amount of careful study can at present dispense with the necessity for exploration in certain cases.

In considering the differential diagnosis there are many conditions to be borne in mind. The following six are the more important (1) Gall-stones (2) gastric crises of tabes (3) duodenal ulcer (p. 373) (4) appendicitis (5) carcinoma (6) visceroptosis (p. 334).

Gall stones —It cannot be too often repeated that biliary colic is a late symptom, and that a large number of patients with stones in the gall bladder suffer only from gastric symptoms, and are treated for gastritis, flatulent dyspepsia, or gastric ulcer." Kraus in 1884 described the early symptoms, and more recently Berkeley Moynihan has laid stress upon them. These "inaugural symptoms" of gall-stones are referred to the stomach the patient complains of pain or discomfort within an hour of taking food, relieved by belching or vomiting There may be a feeling of chilliness after a meal, particularly in the evenings. In these cases there is not the same regularity in the occurrence of pain after meals as in gastric ulcer, and vomiting is more often associated with frequent retching, and does not so frequently relieve the pain. Careful investigation will usually enable a diagnosis to be made. In a few patients, however the pain appears so regularly after meals that the inevitable diagnosis is chronic ulcer This must be the case while X ray examination fails to exclude with certainty the presence of gall-stones or to demonstrate a chronic ulcer

Tabes —The gastric crises of tabes may cause difficulty in diagnosis, particularly when they occur early in the disease, before the appearance of pupil-changes or the loss of knee-jerks. In most cases, however definite signs of tabes, such as lightning pains, are present. The usual symptoms are attacks of frequent vomiting, lasting to two days. Pain may be absent. Tabes is a condition that should be considered in all anomalous stomach cases.

Appendicitis —Cases have come under the care of most surgeons in which patients, after having been treated several years for dyspepsia, develop an attack of acute appendicitis. In the early days of gastric surgery there is no doubt that cases of this nature were treated, without curative result, by gastro-jejunostomy The symptoms may date from an acute attack of appendicitis, but there

2. Direct treatment alone (excision) fails to cure a large percentage.

3. Indirect treatment is curative in suitable instances.

1 Of the potential malignancy of chronic gastric ulcer there is no doubt in the minds of surgeons (see p. 392)

2. Local operations, whether wedge-shaped excision or circular (sleeve) resection, have been followed by recurrence in such a high percentage of cases that they should not be employed alone. Out of 84 cases treated by excision at the Mayo Clinic, 27 required subsequent operation. Moynihan, Deaver and von Eiselsberg, to name a few have found the relapse-rate high after the more extensive operation of circular resection.

3 The actual operation to be performed can only be decided after the abdomen has been opened. This should be done by an incision over the right rectus muscle dividing its anterior sheath the muscle should then be pulled outwards and its posterior sheath and the peritoneum divided. The edges of the wound having been protected with gauze, the whole stomach and duodenum should be carefully examined in order to avoid such a catastrophe as the performance of gastro-jejunostomy on the pyloric pouch of an hour glass stomach, an operation that has been invariably fatal. If no lesion is found on careful examination of both surfaces of the stomach, the posterior being inspected through an opening made in the transverse mesocolon or by separating the great omentum from the colon by the method of Lardennois, the cause of the trouble should be sought elsewhere—in the gall-bladder or appendix. Even when a lesion is found in the stomach, these organs should always, if the patient's condition will permit, be examined and any disease treated. The stomach should not be opened if the lesion cannot be discovered by external examination it is not a chronic ulcer and is unsuitable for surgical treatment. It cannot be too often insisted upon that gastro-jejunostomy must *never* be performed unless a definite lesion is present in the stomach it must never be done for symptoms alone. A chronic ulcer will show definite signs of its presence on inspection or palpation. On inspection, a rough, red-stippled area is usually seen, often somewhat puckered. If the ulcer be on the lesser curvature an enlarged lymphatic gland is frequently present. In the diagnosis from carcinoma, due weight must be placed on the history and on the chemical examination of the stomach contents. If the ulcer be malignant, the peritoneum is *often* thickened and does not show the same rough red appearance, the lymphatic glands are enlarged and hard, and thickened lymphatics are frequently seen running from the growth to the glands.

Ulcers which are "free" undoubtedly heal as the result of

Owing to the impossibility of diagnosing chronic gastric ulcer with certainty apart from operation or direct evidence obtained by X ray examination, statistics based on series of cases in which these methods were not used are unreliable, *as they must include many that are not ulcer.* They do show however the serious nature of the disease and its liability to relapse. Thus of 500 patients admitted to the London Hospital as cases of gastric ulcer previous to 1902, 42 per cent. were suffering from relapses. The death rate was 18 per cent. while in hospital. This obviously understates the danger as of these cases 402 were women, and we now know chronic ulcer to be twice as common in men. Habershon published records of 60 cases of chronic gastric ulcer treated in private practice 24 died, 11 of perforation, 7 of hæmorrhage, 6 of exhaustion.

There can be no doubt that the immediate mortality of the surgical treatment of chronic gastric ulcer even including perforation, is less than the immediate mortality of medical treatment excluding perforation, it is much less. It should also be remembered that chronic gastric ulcer is a precancerous condition (p. 302).

The final results are infinitely better Large numbers of patients have now been traced after operation up to eighteen years.

The result of the surgical treatment of chronic gastric ulcer is now excellent, the immediate mortality low and the percentage of cure high. Thus —

	Operations	*Death-rate*
Mayo Clinic (1900–1920)	1191	3 77
Moynihan (1909–1920) (excluding acute perforation)	235	2·9
Sherren, to December 1 1920 (excluding acute perforation, but including hæmatemesis)	416	3·9

The writer Moynihan, and the Mayos have published long series of cases illustrating the remote results. Of 310 cases operated upon by the writer before December 1917 80 per cent. were cured when traced more than two years later As this includes the earlier cases, results based on this experience are even better

Chronic gastric is a much more serious condition than chronic duodenal ulcer In an investigation, carried out by the Actuarial Society of America, of 2,431 cases of gastric and duodenal ulcer operated on in the Mayo Clinic between 1906 and 1915, all but 708 were traced. During the years following operation the average death rate in the cases operated on for chronic gastric ulcer was three times that of the normal population.

Treatment.—*The treatment of gastric ulcer is at first medical.* Surgical treatment must not be considered, except in perforation or certain cases of hæmatemesis, until the mouth has been attended to not only must obviously carious teeth be dealt with, but pyorrhœa treated and, in suspicious cases, the teeth sockets investigated by X ray examination. If medical treatment fails to relieve the symptoms or relapse occurs, operation should be carried out as offering the patient almost certain relief with the prospect of cure in over 80 per cent. of cases at a very slight risk.

In considering operative treatment three facts should be remembered —

1 A chronic gastric ulcer is potentially malignant.

PERFORATION OF GASTRIC ULCER

Among the complications of gastric ulcer perforation is the most serious fully 95 per cent of the cases thus complicated terminating fatally unless treated by operation. Various figures have been given stating the percentage of cases in which perforation occurs, but all such figures, based as they are upon a diagnosis of gastric ulcer made from symptoms, are useless.

The ulcer which perforates may be an acute one of a few hours or days duration, or a chronic one which has been in existence for many years. In many cases gastric symptoms suggestive of ulceration have been present for a considerable time. The perforating ulcer is more often chronic than acute, even in women Thus, among 248 cases treated at the London Hospital from 1909 to 1919 161 were chronic ulcers 149 were in men, and only 42 ulcers were acute 99 were in women and only 45 were acute.

In the first edition of this System it was stated that perforation of a gastric ulcer occurs most often in women, and that of 133 cases treated between 1899 and 1903, 92 were women. It is difficult to account for this great alteration in sex incidence. Perforation of both acute and chronic ulcers occurs earlier in women than in men thus, 49 out of 99 occurred before the age of 30 in women, and only 25 out of 149 in men before that age

Ulcers which perforate are usually situated on the anterior wall of the stomach, nearer the lesser than the greater curvature and the pylorus than the cardia. Two or more perforations may be found. This is unusual, but should be borne in mind. It was present only once in 14 cases upon which I have operated.

The immediate cause of the perforation is the separation of a slough or spread of the ulceration, but it may occur from over distension of the stomach, or as the result of a sudden strain. As pointed out by Brunton, it is "often directly traceable to mechanical violence, such as coughing, sneezing, convulsion or constriction of the belly" Alexander Miles found that of 30 cases of perforated gastric ulcer treated by him, in 15 the perforation occurred while the patient was at rest. Six were engaged in such a way as to involve muscular strain this percentage is unusually high in 5 only of the cases at the London Hospital did this occur

The perforation may be acute subacute or chronic the first is the most common. The perforation is *acute* when the giving way of the ulcer allows the contents of the stomach to obtain access to the general peritoneal cavity In a *subacute* perforation the stomach is empty or extravasation is limited by adhesions to the abdominal wall, the under surface of the liver or the omentum. In this type of case recovery without operation may take place if the patient be kept at rest and starved. A *chronic* perforation most often occurs when the ulcer is on the posterior wall. It becomes adherent to, and its floor is formed by the pancreas. When the ulcer is on the

gastro-jejunostomy those that have perforated and have an adherent base, or a floor that is formed of a neighbouring organ, do not usually heal completely as the result of this procedure alone. The writer has had the opportunity of proving the healing of free ulcers in 22 cases at post mortem, or in subsequent operations from fourteen days to eleven years later The risk of subsequent development of carcinoma in the scar of an ulcer of this type is remote. The cases in the writer's practice in which it occurred were all cases in which partial gastrectomy would now be done. The operation of gastro-jejunostomy alone should be reserved for small chronic ulcers. As an additional safeguard, the " free " ulcer may be destroyed with a cautery after Balfour's method.

When the ulcer is adherent or has perforated, involving neighbouring organs, if there is any suspicion of carcinoma, and in all large indurated ulcers, partial gastrectomy should be carried out. The method which the author has used since 1911 is a modification of the Billroth II operation, in which the cut end of the duodenum is closed and the jejunum united side to side with the cut end of the stomach (p 419) This method seems first to have been carried out by Polya, who published in 1911 an account of six cases in which he had performed it. This, or some modification of it, is now the operation of choice with many surgeons. On the Continent, Haberer and von Eiselsberg have returned to the method of direct union (Billroth I.).

After treatment.—As soon as the patient has recovered from the anæsthetic he should be propped up in bed in a sitting position. There is, however no necessity to keep rigidly to this he may be moved from time to time and is sometimes more comfortable lying down or even on the side. When he asks for it, as much water or barley water may be given as he desires. He is usually ready for food in about forty-eight hours I am in the habit of ordering Benger's or Allenburys food in preference to milk, but any form of bland diet may be given. Food should be increased cautiously many patients develop a ravenous appetite, but they should be cautioned against over-eating There should be no very hard-and fast rule as to articles of diet the patient's wish should be considered. It is wise to put him on alkalis a powder composed of equal parts of bismuth oxycarbonate, heavy magnesium carbonate, and sodium bicarbonate in doses of 1 dr three times a day is useful. At the end of fourteen days a second test meal should be given in all the cases in which there is increased acidity and only gastro-jejunostomy has been done. The patient should avoid alcohol, and be careful in his diet for at least three months.

It must be remembered that prolonged supervision is necessary after operation

Perforation of Gastric Ulcer

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Ulcers which perforate are usually situated on the anterior wall of the stomach, nearer the lesser than the greater curvature and the pylorus than the cardia. Two or more perforations may be found This is unusual, but should be borne in mind It was present only once in 44 cases upon which I have operated.

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lesser curvature and anterior surface and is adherent to liver the perforation involves this viscus. Very rarely an ulcer at the cardiac end of the lesser curvature becomes similarly adherent to the diaphragm which forms its floor

Symptoms of acute perforation.—It has been stated that perforation may be the first sign of the presence of a gastric ulcer In my experience this is unusual in all the cases under my care symptoms had been present, in most for a considerable time, in one for a week only in a few the symptoms had increased in severity for a short time preceding perforation. When the ulcer which perforates is a chronic one, it is not unusual for the symptoms to have been present for many years. In one of the London Hospital series the patient had had intermittent treatment for 32 years, two for over 20 many for over 12. This is also the experience of Moynihan, who states The perforation of an ulcer of the stomach is a catastrophe which in my experience, never comes unannounced.

The patient is suddenly seized with agonising pain in the epigastric region in some cases the pain shoots to the left shoulder If he is seen quite soon after perforation, shock is, as a rule, absent, and the pulse-rate not increased this should be borne in mind. Board-like rigidity and deep tenderness appear early both signs being first present and most pronounced in the epigastric region. In a few cases this early rigidity may be absent, but tenderness is always present. Gradually the pulse-rate rises, collapse sets in, and the abdomen becomes distended indicating that the most favourable time for operation has passed. The initial severe pain passes off usually in less than an hour.

Vomiting occurs shortly after the onset of the pain in about half the cases but is usually not repeated and is not frequent until peritonitis has developed In many cases the temperature is subnormal directly after the perforation. **Liver-dullness** may be absent if much gas has escaped into the peritoneal cavity but it is not a sign on which reliance can be placed. General subcutaneous **emphysema** has been noticed as a rare complication.

Cases have been recorded in which death occurred from the severe pain or shock of perforation. In one of the London Hospital cases death took place two hours after perforation of an acute ulcer in a girl of 19

In **subacute perforation** there are often for several days premonitory symptoms of stabbing pain, or a feeling of aching or stiffness, but at the time of perforation the symptoms are less acute. Unless operated on, the condition usually leads to the formation of a perigastric or subphrenic abscess (see p. 387)

Chronic perforation.—The only symptom suggestive of this condition when the perforation involves the pancreas or liver may be absence of remissions. There are, however sudden and usually fatal symptoms when, after adhesion to the diaphragm, which in this case forms the floor of the ulcer it suddenly gives way into the left pleura or the pericardium—all accidents of great rarity. Occasionally perforation may occur into the alimentary canal.

Left pleura.—Death may occur suddenly as the result of an acute pneumothorax, or may ensue later from a pyopneumothorax. If the lung has become adherent to the upper surface of the diaphragm, perforation has taken place into it, with the subsequent formation of an abscess which may rupture into a bronchus; or gangrene of lung may occur.

Pericardium.—If the heart is adherent to the diaphragm, perforation may occur directly into the left ventricle. Tylecote, who reports a case, was able to collect only four others. Death results from hæmorrhage. If perforation into the pericardium takes place, death may be immediate from pneumopericardium or occur later from pyopneumopericardium.

Alimentary canal.—Two cases have been under the care of the writer in which perforation into the jejunum occurred, with the formation of a small natural gastro-jejunostomy. Other instances have been recorded of perforation into the third part of the duodenum and into the transverse colon. It is only in perforation into the transverse colon that symptoms are present due to the fistula (see p. 416).

Diagnosis.—No difficulty arises in the majority of cases of acute perforation. The sudden onset of acute abdominal pain in a young woman who has had gastric symptoms previously should lead to the correct diagnosis. In men it is often difficult to decide before operation whether the ulcer is gastric or duodenal, but this is a matter of no importance. But cases occur in which no previous history of gastric trouble can be obtained. In many catastrophes in the upper abdomen no definite diagnosis can be made but these are cases in which the correct treatment is operative—e.g. perforation of the gall bladder or acute pancreatitis.

Acute appendicitis may be simulated by a subacute perforation of the stomach, but with much less frequency than by perforation of duodenal ulcers.

Ruptured tubal pregnancy should also give rise to no difficulty in diagnosis if attention be paid to the history, the onset of the symptoms, and the appearance of the patient.

The sudden onset of an attack of biliary colic may be mistaken for it. This, occurring in a patient who has previously been suffering

from the well known pro-dromal symptoms, may be very suggestive. Careful attention to history and symptoms will enable the diagnosis to be made. In biliary colic restlessness and retching are usually prominent features, absent in perforation.

In acute intestinal obstruction there is the same sudden onset of agonizing pain, but vomiting is a constant feature and the localization of the pain is different.

Neither acute dilatation of the stomach nor gastric volvulus should be confused with perforation of the viscus.

Rare conditions that have misled are mesenteric thrombosis, ptomaine poisoning, abdominal crises in diabetes (Downes and O'Brien), gastric crises of tabes, and hæmorrhage into the ovary about the time of menstruation (Waring).

Cases have occurred in which there has been a sudden onset of severe abdominal pain accompanied by rigidity in patients the subjects of gastric ulcer in whom at operation no perforation was discovered, and other cases in which no cause was found for the symptoms. The phenomenon was called "pseudo-perforation" by Manges, who recorded a case of this nature.

Very rarely, as in the case recorded by Moore, another lesion is present; in this case perforated gastric ulcer was complicated by acute appendicitis.

Prognosis.—Death is inevitable in over 95 per cent. of the cases not treated by operation. The prognosis depends upon the time after perforation at which operation can be performed. If the patient is seen within the first twenty four hours the death-rate should be not more than 10 per cent.

Sinclair Kirk has recorded 11 cases in which he operated, with recovery in all. In 8 cases the operation was done within five hours of perforation, in 1 at seven, in 1 at ten, and in 1 at twenty hours.

The death rate at the present time in large numbers of cases is about 50 per cent. Thus, Gross and Gross collected the reports of 369 operations with a death rate of nearly 51 per cent. The death-rate at St. Thomas's Hospital (Sargent) for the fifteen years up to 1904 was 55 per cent., at St. Bartholomew's, between 1897 and 1905, 40 per cent. (90 cases). In 16 cases operated on by the writer within twenty four hours of onset, all recovered. In 28 cases over this period, the death-rate was 50 per cent.

Treatment.—Abdominal section should be performed at once; no time should be wasted in waiting for "shock" to pass off for this will be best relieved by immediate operation. It must be remembered that if the case is seen early there may be no shock.

The abdomen should be opened through a right paramedian incision. In many cases, as soon as the peritoneum is reached it is seen to be blown out in a bladder like way by the air contained in the peritoneal cavity. The stomach should be quickly found. As

a rule the perforation is easily discovered, as it is usually on the anterior wall. Unless the case be very recent, it will generally be surrounded by yellow lymph. If the ulcer is not seen on the anterior surface or in the duodenum, a wide opening should be made in the gastro-colic omentum and the posterior surface examined. If no ulcer is present, the gall bladder and pancreas must be examined and then the appendix and pelvic organs.

If the ulcer which perforates is an *acute* one the perforation should be infolded, hardened catgut being used. Gastro-jejunostomy should never be done in these cases. If the condition of the patient permit, search should be made for other abdominal disease, particularly in the gall bladder and appendix.

It is sometimes impossible to close the perforation in this way on account of the friability of the tissues immediately around the ulcer or the amount of induration present; in these cases the ulcer should be rapidly excised, or if the condition of the patient will not permit, a piece of omentum may be brought up and stitched over the ulcer, or if this is impossible, the perforation should be covered by gauze packing.

As perforation of two ulcers has occurred simultaneously in many recorded cases search should always be made for other lesions.

When the ulcer which has perforated is a *chronic* one, if the condition of the patient will permit, it should be treated as ulcer without this complication. If his condition will not admit of this, closure only should be carried out, and radical treatment adopted two or three months later. That this is necessary is shown by the recurrence of ulceration after excision (see p. 365). Among the perforating chronic ulcers treated at the London Hospital by infolding or excision only there were four in which second perforation occurred with fatal results.

After the perforation has been dealt with, all extravasation should be gently wiped away and the abdomen closed without drainage, unless the extravasation has been considerable, when a tube brought out on the loin should be placed in the right or left kidney pouch according to whether the extravasation has been from an ulcer at the pyloric or the cardiac end. If the peritoneal soiling has been general it will be well to drain suprapubically also. These tubes can usually be removed in 24–48 hours, and should not be retained longer than the latter period.

After-treatment.—After operation the patient should be nursed in the propped-up position and as soon as postanæsthetic vomiting has passed off should be allowed water. It is unnecessary to institute rectal feeding, for within thirty-six hours of operation the patient should be taking Benger's food, or albumin-water and glucose.

Careful attention must be paid to the mouth to avoid parotitis.

If general peritonitis is present nothing should be given by the mouth until vomiting has ceased and the condition of the patient shows that feeding is safe. Continuous saline infusion is carried out per rectum After from twenty four to thirty-six hours, if the condition of the patient is satisfactory water may be given by the mouth, and a start made on albumin water and glucose, Benger's food, or milk and water but if this causes increase in pulse-rate or vomiting it should not be persisted in. On no account should aperients be given, and the resumption of food should be gradual.

A continuing temperature with gradual loss of flesh should raise suspicion that a subphrenic abscess is present this should be sought (see p 387) and treated in the usual way

After the patient is free from danger all carious teeth should be removed and alkalis given

Ultimate prognosis.—If the ulcer which perforated is acute, situated on the anterior surface of the stomach and capable of being infolded no further symptoms will develop in most cases. If, on the other hand, the ulcer is a chronic one symptoms will probably recur unless treatment was carried out at the time the perforation was closed.

Perigastritis—Gastric Adhesions

Adhesions connecting the stomach to the abdominal wall or to other viscera are commonly due to gastric or duodenal ulcers, but may be due to diseases of other abdominal viscera, most commonly the gall bladder As a rule no symptoms are produced.

Through the attachment of the great omentum to the stomach this organ may be interfered with in disease of any part of the abdomen. In one patient upon whom I operated, gastric symptoms, which at one time had been thought to be due to gastric ulcer were found to be caused by adhesions of the great omentum to the uterus at the site of a previous removal of the left Fallopian tube

In the majority of cases, adhesions, whether due to extrinsic or intrinsic causes give rise to no symptoms whatever In the pyloric region, as the result of constriction or fixation of the pylorus at a higher level than normal dilatation may result (see p 341). Adhesion of the stomach to the anterior abdominal wall, or constriction by adhesion, may lead to hour-glass stomach. In such cases as these definite symptoms of stenosis will be present.

It is in the cases in which pain is the prominent feature that difficulties are most likely to occur Pain arises most often when the adhesions are to the most movable portion of the stomach the greater curvature. Hale-White, speaking of this subject, says I

am not sure, but I think they most often give rise to symptoms when they connect the stomach with the bowel.

The pain is often worse after food, but it may be absent for days and weeks, and in some cases bears no relation to meals. It is often worse on exertion, and the patient may complain that the pain is increased on reaching above the head or standing quite erect. The long-continued pain may set up neurasthenic symptoms.

There may be distinct deep tenderness with muscular rigidity over the area occupied by the adhesions.

Diagnosis.—This must rest on the history of previous abdominal trouble such as might cause a local peritonitis

Treatment.—If the adhesions have caused hour-glass stomach or gastric dilatation the appropriate treatment for these conditions must be carried out. When pain is the chief complaint, and is of sufficient severity to interfere with the patient's work, operation should be undertaken for the purpose of dividing the adhesions, care being exercised to avoid overlooking any perforation of stomach which may have been closed by them The adhesions should be cleanly divided, and both ends ligatured If a large raw surface is left omentum may be used to cover it.

Attempts at preventing the re-formation of adhesions by covering the raw surface with Cargile membrane or by leaving saline solution in the abdominal cavity have not been successful

Symptoms may persist after the division of adhesions particularly in women in whom neurasthenia has supervened.

DUODENAL ULCER

Ulcers resembling those occurring in the stomach, and probably caused in a similar way (see p. 342), are frequently found in the duodenum. They may be divided into the acute and the chronic.

Etiology.—As in the stomach, the *acute* ulcers may be found complicating many diseases, especially those in which sepsis is present. There is a close association between chronic appendicitis and duodenal ulcer it is probable that the appendix is the source of the infection in many cases.

Burns.—Ulcers occurring in the duodenum complicating severe burns were described by Curling in 1842 (Fig. 380); and it is said they may also be present in the stomach, and in the intestine lower down. Usually single they are met with most often in the first portion and begin as hæmorrhagic erosions. They are said to occur as a rule from seven to fourteen days after the burn, but they may be discovered earlier—in one case (Parfick) they were seen within eighteen hours. These ulcers often lead to a fatal issue within a few days, from hæmorrhage or perforation. They were more frequently met with by older writers. Thus, Fenwick, from the statistics of Holmes, Erichsen, Perry and Shaw found this complication in 6 2 per

cent. of all fatal cases of burns These ulcers are now not often found after burns, and some authors deny that the two conditions are associated Various explanations have been given of the development of these acute ulcers, but they are probably of toxæmic origin, and can thus be brought into line with other acute peptic ulcers (p. 356).

Age.—Duodenal ulcers may be met with at any age. Cases have been recorded of the perforation of a duodenal ulcer in an infant of 21 hours, and of death from hæmorrhage from a duodenal ulcer in an infant 2 days old. In infants diagnosis is impossible in the absence of hæmorrhage.

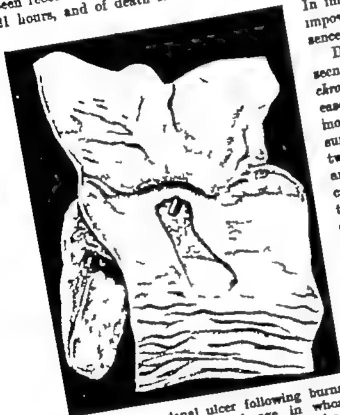


Fig 380—Duodenal ulcer following burns, from a girl 7 years of age, in whom death took place eight days later from hæmorrhage from the pancreatico duodenal artery (Curling's case.)

(Royal College of Surgeons Museum.)

Duodenal ulcer as seen clinically the *chronic* ulcer is a disease of adult life, which most often comes under surgical observation between the ages of 30 and 50 In many cases, however symptoms were noticed much earlier in life for instance in one patient of 53 upon whom I operated, symptoms had been present for thirty five years, and in another of 68 for forty-eight.

Sex.—All are agreed that men are more often affected than women. Of 583 patients operated on by the writer to December 1920 80 per cent. were males. Of 218 patients with perforated duodenal ulcer operated on at the London Hospital between the years 1909 and 1919 only 17 were women. This may be connected with the greater frequency of diseases of the appendix in men and with the fact that gastric acidity is higher in men than in women and that the male stomach is usually of the hypertonic type (*see* p 314)

Situation.—Ulcers occur most often in the supra-ampullary portion of the duodenum, over 95 per cent. being found within an inch of the pylorus. The ulcer is usually solitary and situated on the anterior wall next in order of frequency on the posterior wall. An ulcer in this latter situation is particularly liable to be associated with hæmorrhage which may prove rapidly fatal from erosion of

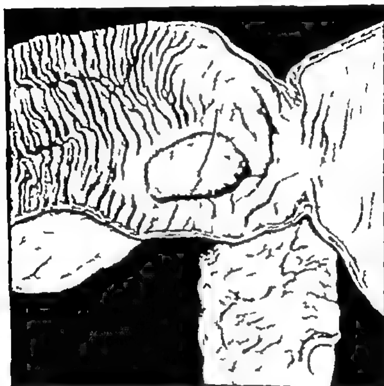


Fig 391.—Chronic ulcer situated on the posterior wall of the first part of the duodenum, which had eroded the gastro-duodenal artery. A bristle is in the artery the body of the pancreas has been displaced downwards.

(*London Hospital Pathological Institute.*)

the gastro-duodenal artery (Fig. 391). Occasionally two ulcers are present on opposite sides of the intestine (see Fig 392)

The **morbid anatomy** of duodenal ulcer resembles that of gastric ulcer with which it coexists in about 5 per cent of the cases.

Symptoms.—A chronic duodenal ulcer may be latent until perforation or hæmorrhage occurs. In the majority of patients, however it gives rise to a definite train of symptoms in a few it cannot

be distinguished from a gastric ulcer and in still fewer the diagnosis of peptic ulcer is not made at all.

Thus we may conveniently make four groups of cases of duodenal ulcer:—

1. Those with typical symptoms.
2. Those with symptoms that are indistinguishable from gastric ulcer.
3. Those in which diagnosis is impossible.
4. Those presenting no symptoms till perforation.

The important feature is the complete remission of symptoms, an attack lasting a few weeks being followed by a period of perfect

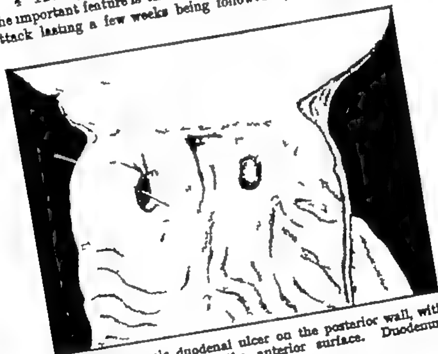


Fig. 282.—Chronic duodenal ulcer on the posterior wall, with perforated ulcer on the anterior surface. Duodenum opened from below.

(*London Hospital Pathological Institute.*)

health which may last for months. An attack is particularly prone to come on in the winter and may result from cold, from worry or from overwork.

The onset of the disease is usually insidious: at first there is only a sense of uneasiness, or a feeling of distension. The persons in whom it occurs are, as a rule, healthy men leading active lives.

The first symptoms usually appear between the ages of 20 and 35; it is very unusual for them to do so after 50. If symptoms suggestive of this condition appear late in life, carcinoma of the stomach should be suspected.

Pain is rarely absent, and is the most important symptom it appears about two hours after food, and lasts until the next meal by which it is relieved—hence the name "hunger pain" applied to it by Moynihan. A characteristic feature of the pain is that in many cases it wakens the patient about 1 or 2 a.m. It is epigastric and may pass round to the right side, is often relieved by pressure, and may be accompanied by eructation of gas or regurgitation of a little bitter fluid, followed by relief. *Occasionally it is spasmodic*, doubling the patient up and resembling biliary colic. It is sometimes noted that the period of relief from the pain is greater after the ingestion of solid than of liquid food. The appetite frequently remains good indeed, it may be better during the attack than at other times.

Spontaneous **vomiting** is very unusual unless stenosis occurs but self induced vomiting, rare in gastric ulcer is noted in many cases of duodenal ulcer

During the attack, **rigidity** of the upper segment of the right rectus muscle and **deep tenderness** may be present, but often abdominal examination is negative.

Symptoms such as those described above are present in most cases in which an ulcer is situated in the first part of the duodenum. If they are associated with hyperacidity the diagnosis is certain. This type represents above 75 per cent. of the cases.

Occasionally the ulcer is situated in the second part of the duodenum. In these cases the symptoms are often atypical, and jaundice may occur it may be impossible to make a diagnosis between duodenal ulcer and gall-stones. In about 4 per cent. of the cases symptoms are absent until perforation takes place or hæmorrhage occurs. Still more rarely the symptoms are those of painless attacks of dilated-stomach vomiting.

Complications.—**Stenosis** of the pylorus may result after many years chronic duodenal ulcer is the most frequent cause of obstructive dilatation of the stomach.

Hæmorrhage.—It is difficult to estimate the frequency with which bleeding occurs. Balfour states that 20 per cent. of duodenal ulcers have been complicated by one or more gross hæmorrhages. The blood may be vomited, but generally only appears in the fæces. Slight hæmorrhage such as may be discovered by tests for "occult blood," is probable in most cases. Severe hæmorrhage is a late and serious complication. The bleeding may come on without warning and cause sudden faintness, followed by the passage of a tarry motion with or without the vomiting of blood. In other cases it may occur insidiously without the knowledge of the patient. The bleeding may be fatal, the source of the blood being the gastro-duodenal, superior

pancreatico-duodenal, right gastro-epiploic, or pyloric artery In a few cases death has been sudden.

Jaundice may develop as the result of the cicatrization of ulcers of the second part of the duodenum, or of the spread of inflammation into the common bile-duct or pancreas, but is a rare complication.

Pancreatitis may be present due to a spread of the associated duodenal inflammation.

Diagnosis.—In about 75 per cent. the typical character of the recurring attacks of hunger pain, associated with hyperchlorhydria will render the diagnosis certain. Difficulty arises in those which do not conform to this type. It must not be considered that hunger pain, or pain two or three hours after food relieved by taking food, is found only in association with duodenal ulcer for it occasionally occurs in cases of *gastric ulcer* situated on the lesser curvature or posterior surface of the stomach, and also in *carcinoma* . In *cholelithiasis*, attacks of pain two or three hours after food may cause duodenal ulcer to be thought of, but in these cases the pain is not relieved by a warm drink or soda bicarbonate, as in duodenal ulcer moreover in cholelithiasis retching and vomiting are common, while they are usually absent in duodenal ulcer The pain is also occasionally met with in chronic appendicitis.

Recurrent attacks of definite hunger pain are always due to a definite organic lesion that can be dealt with surgically

The examination of the gastric contents after a test meal is of great service in enabling a diagnosis to be made. Chronic duodenal ulcer uncomplicated by secondary gastric dilatation is associated with an excess of free HCl, and the total acidity is high the average being, in men, free HCl 0·16 total acidity 70 in women, 0·10 and 50 respectively In cholelithiasis this is unusual in longstanding cases free HCl is usually absent and the total acidity is low

X ray examination after a barium meal may reveal a hypertonic stomach emptying rapidly more rarely deformity of the duodenal cap or the definite crater of an ulcer (*see* p. 323)

Prognosis.—Chronic ulcer of the duodenum is a disease with the possibility of grave complications. Unless these occur however it is one compatible with a long, active life. I have operated on patients who had had symptoms for 48, 40 36 years, and many over 30 The risk of perforation is great—how great it is impossible to estimate.

The immediate results of operation are extremely good.

	Cases	*Death rate*
Moynihan (from 1900)	563	0·53 per cent.
Sherren	637	10 deaths (including cases operated on for hæmorrhage).
Mayo Clinic (1914–19)	2,734	1 per cent.

The remote results are excellent. At least 90 per cent. of the cases can be cured by operation; less than 2 per cent. of the operations are failures. The after history of cases operated on in the Mayo Clinic has been investigated by Hunter who found that the average death-rate in the four years succeeding operation was slightly less than in normal individuals.

Treatment.—At the first attack the patient should have a full trial of medical treatment with rest in bed, after thorough treatment of all septic foci. It is impossible to estimate the prospect of success by this treatment, but it has failed to cure in many cases. Ambulatory treatment is certainly a failure. I have operated upon patients in whom perforation had occurred while under treatment which included complete rest in bed.

Operation should be carried out in all cases in which thorough medical treatment has failed to cure. Although the condition was first treated by **gastro-enterostomy** by Codivilla in 1893 it is only of recent years that its correct treatment has been recognized owing, in great measure, to the work of Moynihan and the Mayos.

The abdomen should be opened by displacing the right rectus muscle. The ulcer is usually found on the anterior part of the first portion of the duodenum. The peritoneum over it presents a speckled reddish appearance, and a definite induration can be felt between the finger and thumb. When the ulcer is situated on the posterior portion of the duodenum, it may usually be felt through the anterior wall or by picking up the duodenum between finger and thumb. In some cases adhesions are present binding the duodenum to the gall bladder or liver. In every operation in which the condition of the patient permits, the gall bladder and appendix should be examined, and surgically treated if necessary.

After examination of the stomach for signs of ulcer posterior no-loop gastro-jejunostomy should be carried out. That this is sufficient in most cases is shown not only by the long series recorded in which absolute relief of symptoms occurred, but by demonstration at a second operation performed for some other condition. I have had the opportunity of examining the site of the ulcer post mortem in 9 cases from six days to nine years later. In all except the first the ulcer had healed. At subsequent operation I have been able to investigate the condition of the duodenum in 23 of my patients at periods from two months to ten years after gastro-jejunostomy; the ulcer had healed in all.

It was formerly considered advisable to infold ulcers situated on the anterior surface as cases had been recorded in which hæmorrhage or perforation had occurred with fatal results after posterior gastro-jejunostomy. These dangers must be of great rarity; none have come under my observation. As I have no doubt that obliterating

pancreatico-duodenal, right gastro-epiploic, or pyloric artery In a few cases death has been sudden.

Jaundice may develop as the result of the cicatrization of ulcers of the second part of the duodenum or of the spread of inflammation into the common bile-duct or pancreas, but is a rare complication.

Pancreatitis may be present due to a spread of the associated duodenal inflammation.

Diagnosis.—In about 75 per cent. the typical character of the recurring attacks of hunger pain, associated with hyperchlorhydria will render the diagnosis certain. Difficulty arises in those which do not conform to this type. It must not be considered that hunger pain, or pain two or three hours after food relieved by taking food, is found only in association with duodenal ulcer for it occasionally occurs in cases of *gastric ulcer* situated on the lesser curvature or posterior surface of the stomach, and also in *carcinoma* In *cholelithiasis* attacks of pain two or three hours after food may cause duodenal ulcer to be thought of, but in these cases the pain is not relieved by a warm drink or soda bicarbonate, as in duodenal ulcer moreover in cholelithiasis retching and vomiting are common, while they are usually absent in duodenal ulcer The pain is also occasionally met with in chronic appendicitis

Recurrent attacks of definite hunger pain " are always due to a definite organic lesion that can be dealt with surgically

The examination of the gastric contents after a test-meal is of great service in enabling a diagnosis to be made. Chronic duodenal ulcer uncomplicated by secondary gastric dilatation is associated with an excess of free HCl and the total acidity is high, the average being, in men, free HCl 0·16 total acidity 70 in women, 0·10 and 60 respectively In cholelithiasis this is unusual in longstanding cases free HCl is usually absent and the total acidity is low

X ray examination after a barium meal may reveal a hypertonic stomach emptying rapidly more rarely deformity of the duodenal cap or the definite crater of an ulcer (see p. 323)

Prognosis.—Chronic ulcer of the duodenum is a disease with the possibility of grave complications. Unless these occur however it is one compatible with a long, active life. I have operated on patients who had had symptoms for 48 40, 36 years, and many over 30 The risk of perforation is great—how great it is impossible to estimate.

The immediate results of operation are extremely good.

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the duodenum is one of the causes of secondary ulceration, it should never in my opinion, be done (see p 365)

In patients with a history of hæmorrhage the ulcer should be directly dealt with, either excised or destroyed with the cautery and the opening closed so as not to narrow the pylorus. In these cases, particularly when the ulcer is situated on the posterior surface of the duodenum, bleeding may recur if posterior gastro-jejunostomy alone is done. Posterior ulcers should therefore always be directly treated, for although the patient may be entirely freed from his digestive disturbance, attacks of painless hæmorrhage may occur. Balfour records recurrence of hæmorrhage in 12 7 per cent. of cases.

The **after-treatment** should be similar to that carried out in chronic gastric ulcer and should be checked by the postoperative test meal, which should reveal absence of free HCl and a material diminution in the total acidity If this has not taken place, prolonged medical treatment must be instituted to guard against the development of a jejunal ulcer

Hæmorrhage must be looked upon as a serious symptom, and operation carried out as soon as the patient can stand it, usually within forty-eight hours. It will rarely be justifiable to operate during the course of the bleeding, but if the patient has had a severe hæmorrhage, and the bleeding recurs while he is absolutely at rest, operation without loss of time is indicated. The ulcer should be destroyed and gastro-jejunostomy done.

Perforation of Duodenal Ulcer

It was formerly the custom to state that perforation was relatively more frequent in duodenal than in gastric ulcer While this is probably true as regards *chronic* ulcer we have no means of proof. Perforation, however of an *acute* duodenal ulcer is a rarity

The perforation is more common on the anterior wall of the first part of the duodenum—90 per cent. of the cases. (Fig 383.)

Symptoms.—A few years ago it was thought that duodenal ulcer was often latent, and that the first indication of its presence might be perforation. Now that its symptoms are better known, it is recognized that in most cases they have been present for years, and that the ulcer which has perforated is a chronic one.

Thus, in 14 out of 15 cases recorded by Mitchell, a history of previous dyspepsia was present, in the majority of them typical of chronic ulcer I found that of 218 cases a history of previous dyspepsia was absent in 6 only

The perforation may be acute, subacute, or chronic. It is much more frequently *subacute than in gastric ulcer and consequently*

the symptoms may not be so definite as those of a perforated gastric ulcer.

If the ulcer is situated close to the pylorus, and the opening is a large one, there is a sudden escape of gastric contents, causing severe epigastric pain, followed by abdominal rigidity with the same absence of early severe shock as in perforation of a gastric ulcer. But if the perforation is a small one, or is situated at the junction of the first and second parts of the duodenum, or in the second part, the escaped fluid may track down into the right kidney pouch. Maynard Smith has experimentally investigated the course taken by fluids escaping from the duodenum, with results corresponding to those found clinically.

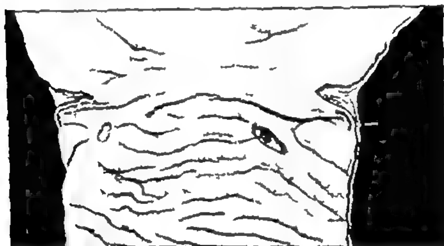


Fig. 382.—Perforation of an acute ulcer situated on the anterior wall of the first part of the duodenum. Small chronic ulcer on the posterior wall. Stomach and duodenum opened from above.

(London Hospital Pathological Institute.)

The fluid in every case ran down and collected in the right kidney pouch, then passed down along the outer side of the ascending colon as far as the pelvis, into which it overflowed.

In these cases the symptoms are by no means typical and in the absence of a previous history pointing to duodenal ulcer are very liable to be mistaken for appendicitis. It should be borne in mind that the two diseases may coexist, and that cases of simultaneous perforation of a duodenal ulcer and acute appendicitis are not unknown.

In subacute and chronic perforation the opening may be closed by the gall bladder, less commonly by the liver. In the chronic variety there is usually erosion of the pancreas. In both there may be the

gradual development of a subphrenic abscess this abscess is usually of right anterior localisation, but cases have been recorded by Box and Rolleston in which it was left-sided.

Diagnosis.—In the first group of cases the diagnosis cannot be made from a perforated gastric ulcer except on the previous history In the cases with subacute symptoms of perforation or with signs resembling those of appendicitis, care in eliciting the previous history and that of the onset of the lesion will enable the diagnosis to be made. Generally this will be possible the onset of acute abdominal symptoms in an adult male should always raise the suspicion that the duodenum is at fault.

Occasionally the perforation is retroperitoneal with the gradual formation of a swelling in the right loin usually associated with contraction of the psoas muscle. The abscess may simulate a psoas abscess due to spinal disease, and may point in the inguinal region. There is no absolutely sudden onset, but pain with a raised temperature. If the previous symptoms of ulcer have not been typical, the diagnosis is not made until after the abscess has been opened and a duodenal fistula forms. These cases are rare one successfully treated by operation has been recorded by Lawford Knaggs, and another was successfully treated recently by B. K. Martin.

It might be supposed that if the abdomen has been opened on the diagnosis of a perforated peptic ulcer no further difficulty will arise yet in one such case the discovery of fat necrosis at the root of the mesentery led me to abandon further search. In this case an ulcer of the second part of the duodenum had perforated and permitted the escape of pancreatic juice into the peritoneal cavity A similar instance of fat necrosis associated with a perforated duodenal ulcer has been since recorded by H. M. Richter

Treatment.—The abdomen should be opened through a right paramedian incision. As a rule, the ulcer is at once seen. The perforation should be closed in such a way as not to obstruct the pylorus, and gastro-jejunostomy performed if the condition of the patient permits. After examination for further perforations the right kidney pouch should be carefully sponged out and the abdomen closed. If necessary the right renal pouch should be drained, and, in addition, if there has been extensive peritoneal soiling, a tube may be placed suprapubically The after-treatment follows the lines laid down for cases of perforated gastric ulcer (p 371).

Prognosis.—At the present time owing chiefly to the less acute onset of many cases of perforation the death-rate is higher than in similar perforations of the stomach.

The death-rate is steadily falling thus, in the first 20 cases recorded in 1899 (Pagenstecher) it was nearly 86 per cent. As know

ledge of the early symptoms which accompany perforation becomes widely spread, earlier operation will render treatment more successful, and recognition of chronic duodenal ulcer will lead to the prevention of perforation by appropriate treatment.

Mayo Robson collected 165 cases, with a mortality of 66 per cent.; during 1899–1908, 42 cases were operated upon at the London Hospital, with a death-rate of 80 per cent.; and during 1909–1919 218 cases, with a mortality of 49 per cent.

A. B. Mitchell of Belfast has published a series of 16 consecutive operations for perforation, without a single death. Of these cases, 11 were operated upon within 12 hours of perforation, 6 within 15 hours, 1 each at 17½ 18, 25, 36, and 49 hours after perforation. The writer has operated on 46 cases with 30 recoveries. Of 24 cases operated upon within the first 24 hours, all recovered except 2, one of whom was suffering from advanced pulmonary and genito-urinary tuberculosis, and in the other I found fat necrosis and overlooked the perforation.

HÆMATEMESIS

Hæmatemesis occurs in many diseases, and is generally associated with a gastric lesion, which may be an erosion due to the mucous membrane giving way over the bleeding point, or may be the result of acute ulceration. It is, however often met with in patients who show no evidence of the latter With regard to this, Moynihan writes That gastric hæmorrhage occurs, and occurs profusely in ulceration both of the stomach and duodenum is certain but the number of other conditions that give rise to hæmorrhage is so large that the possibility of a gastric ulcer being the source of the blood should not be strongly or exclusively held

Cases of hæmatemesis fall into three groups (1) The bleeding is the first obvious symptom of disease (2) postoperative (3) in patients presenting the symptoms of chronic gastric or duodenal ulcer

1 Bleeding without Premonitory Symptoms

In this group the patients are usually anæmic young women. The *hæmorrhage* is the first symptom in 75 per cent. of the cases in the remainder it may have been preceded for a few days or weeks by symptoms suggestive of gastric ulcer The hæmorrhage is alarming and profuse, but is very rarely fatal. Tuffier has stated that the death-rate is only 1 7 per cent. when it is medically treated this corresponds with my experience

Instances have been recorded in which at operation or at the post-mortem examination no ulcer could be discovered. Hale-White collected 29 such examples of this condition and suggested for it the name *gastrostaxis* (p. 361)

It is difficult to examine the interior of the stomach *satisfactorily* during life and recent acute ulcers or erosions are easily overlooked

even post mortem unless the stomach be carefully examined with a lens. Probably there is a definite lesion of the mucous membrane in all the cases in this group

It should be remembered that profuse painless hæmatemesis may be the first symptom to attract attention in disease of the spleen, and may occur in cirrhosis of liver Occasionally it is the first symptom of carcinoma of the stomach.

Careful history taking and thorough investigation are necessary for successful treatment all the possible causes should be considered and we should remember that the hæmatemesis we are called on to treat is usually a symptom of disease elsewhere.

Treatment.—Operation should never be undertaken in these cases the death-rate is over 60 per cent., and the bleeding has recurred after all forms of treatment.

Absolute rest in bed should be insisted upon and a hypodermic injection of morphia given. High rectal injection of hot water from 112 to 120° F (Tripier), repeated once or twice, may be useful. *Nothing should be given by mouth for forty-eight hours, salines being* given per rectum every six hours. At the end of forty-eight hours feeding may be carefully begun, first with small quantities of albumin-water gradually increased if well taken, and followed by Benger's food or milk-and water

So soon as the condition of the patient will admit, thorough search should be made for possible sources of infection, particular attention being paid to the mouth.

3 Postoperative Hæmatemesis

Hæmorrhage from the stomach occurs occasionally after laparotomy and in rare instances after operations upon other parts of the body In most cases the operation has been for some septic condition in these the general state of the patient is bad and indicative of a severe toxæmia. The hæmatemesis usually occurs within twenty four hours, although it may be delayed, particularly in such cases as appendicitis, in which there is prolonged sepsis. As a rule the blood vomited is altered in colour and the name "black vomit" has been given to it.

The death-rate of this condition is high Purves estimated it at 69 per cent. This is in accordance with experience at the London Hospital.

Several theories have been put forward with regard to its causation (1) That it is due to sepsis. (2) That it is "dependent on a reflex nervous influence" (Mayo Robson) (3) That it is due to injury to the omentum (v Eiselsberg). (4) That it is due to the anæsthetic.

Sepsis as first shown by Rodman is the cause in most cases. It is now known that gastric erosions and gastric ulcers are relatively common complications of septic conditions. The hæmorrhage has the same origin as that in the first group from definite lesions of the mucous membrane of the stomach.

Thus, during the years 1907-9 19 acute ulcers—18 of stomach and 1 of duodenum—were found at the Pathological Institute of the London Hospital in patients who died shortly after operation. In none of these cases had hæmatemesis or melæna occurred. In 12 the operations had been undertaken for acute appendicitis, in 3 for acute intestinal obstruction, in 1 for infective gangrene of the leg, in 1 for papilloma of the bladder in a patient with pyuria, and in [illegible] for disease of the gall-bladder. During the same period 8 patients died with postoperative hæmatemesis. In 3 cases it originated after operation for acute appendicitis, in 2 after operation upon the gall bladder and in 1 each after external urethrotomy hysterectomy and epithelioma of the tongue. In the last two of these cases the hæmorrhage arose from a chronic gastric ulcer which had eroded the coronary artery and a chronic duodenal ulcer with an erosion of the gastro-duodenal artery Of the remainder, in 1 case erosions were found in the duodenum, in [illegible] cases an acute gastric ulcer was found, in 1 a bleeding erosion was discovered at operation, in 1 no cause could be found post mortem, in another no post-mortem was obtained.

Postoperative hæmatemesis is the result of septic gastritis in the majority of cases but hæmatemesis may occur from acute infection of a chronic ulcer which has been in existence for some time without giving rise to symptoms sufficiently severe to need treatment.

Hæmorrhage may occur after operations on the stomach immediately or at remote periods (see pp. 427 431)

Treatment.—Patients in whom this condition arises are always desperately ill. If the vomit is black, frequent, and small in amount gentle lavage with warm water to which 1 dr of bicarbonate of soda to the pint has been added, should be employed and repeated if necessary The toxæmia should be combated by continuous saline injection per rectum.

3 Hæmatemesis from a Chronic Gastric or Duodenal Ulcer

This is a serious complication and leads not infrequently to a fatal result. Cecil Wall investigated the death-rate among the patients admitted into the London Hospital with hæmatemesis due to chronic gastric ulcer and found that it was 12½ per cent. in men 6½ per cent. in women. It is far in excess of this, for included are many which are certainly not cases of chronic ulcer It is not yet sufficiently realized that death from this cause is common MacKevin and Herrick found hæmatemesis to be the cause of death in 25 out of 55 cases of chronic ulcer which came to post mortem.

The bleeding occurs usually from an artery of medium size, although it may take place as the result of ulceration into a vein. A small aneurysm often forms on an artery exposed in the floor of the ulcer ruptures, and gives rise to profuse bleeding, the artery being unable to retract. The hæmatemesis may be acute and lead to death so rapidly that there is no time for surgical treatment. This was the result in 8 out of 54 fatal cases collected by Savariaud in these cases the bleeding most often occurs from the splenic artery but in very rare instances it is caused by perforation into the heart. Usually however the bleeding ceases spontaneously only to recur later with perhaps a fatal result. The coronary pancreatico-duodenal, and right gastro-epiploic arteries are the common sources of the bleeding

Treatment.—In this group operation should be carried out in all cases it must be undertaken as soon after the cessation of the first bleeding as the patient's condition will permit, which will usually be in 36–48 hours. During this time absolute rest and the avoidance of oral feeding are essential. If in spite of this treatment the bleeding continues or recurs, operation should be resorted to without delay During the period of waiting after the first attack, a careful watch must be kept to see that bleeding is not continuing although no blood is being vomited.

Direct treatment of the bleeding-point is necessary The condition is comparable to a secondary hæmorrhage. It has been stated that gastro-jejunostomy is sufficient to arrest the bleeding this is probably true when the blood is coming from a small vessel but there is no way of telling the size of the vessel, and it is safer to treat the ulcer directly

After opening the abdomen, the stomach should be carefully examined and if an ulcer is seen on the lesser curvature it should be excised, or destroyed with the cautery and gastro-jejunostomy performed. If this is impossible from its size, or if the ulcer is situated on the posterior surface of the stomach and adherent to the pancreas, *partial gastrectomy should be done* if the condition of the patient admits. If it does not, the stomach should be opened, the floor of the ulcer should be carefully examined and any vessels that have ruptured should be tied on both sides. Radical operation should be carried out so soon as the condition of the patient allows.

If the ulcer is duodenal and situated on the anterior surface, it should be destroyed with the cautery and the wound sutured in such a way that the pylorus is not narrowed. If it is situated on the posterior surface, excision should be done, or the duodenum opened and the vessel ligated. Posterior gastro-jejunostomy should complete the procedure

If the stomach and duodenum appear to be normal the gall bladder and appendix should be dealt with if diseased. No operation should be performed on the stomach.

PERIGASTRIC ABSCESS

This is usually due to the perforation of a chronic gastric ulcer or to imperfect drainage of the abdominal cavity after operation for perforation.

When a perigastric abscess is the result of an ulcer on the anterior wall of the stomach this viscus forms the lower boundary of the abscess cavity the gastro-hepatic omentum the posterior wall and the liver the upper wall. Such an abscess may burst through the

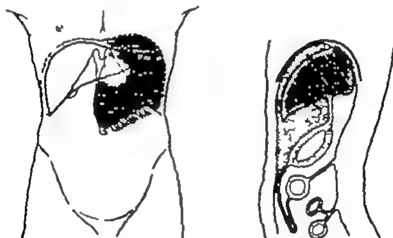


Fig. 384—Diagrams to illustrate abscess in left anterior intraperitoneal fossa (*Barnard*)

skin, or may open into the colon, causing a gastro-colic fistula, or may become subphrenic.

As a rule, ulcers which perforate chronically are situated on the posterior surface of the stomach, and a subphrenic abscess may be the result.

Subphrenic abscess (see *also* p 588) is most commonly caused by perforation of a gastric or duodenal ulcer Of 76 cases recorded by Barnard, it was due to this cause in 26, the ulcer being gastric in 21 and duodenal in 5 cases. The fossa affected is ordinarily the left anterior intraperitoneal (Barnard) This fossa is bounded above by the diaphragm, below and to the right by the left lobe of the liver on the left by the spleen, and below by adhesions of the omentum to the abdominal wall (Fig 384). Signs of interference with the base of the left lung are usually present. An abdominal swelling can be

recognized occupying a triangular area limited by the costal margin on the outer side, and by a line convex to the right joining the umbilicus to the ensiform and the ensiform to the costal margin. Gas is usually present, giving rise to resonance at the upper part of the swelling

When the perforation is at the pylorus or in the duodenum the right anterior intraperitoneal space may be affected (Fig 385). Of 37 abscesses of this type, 4 were the result of perforation of a gastric and 2 of the perforation of a duodenal ulcer This fossa is situated between the diaphragm above, the right lobe of the liver below and the falciform ligament to the left.

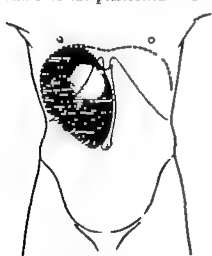


Fig. 385.—Diagram to illustrate abscess in right anterior intraperitoneal fossa. (*Barnard*)

The right posterior fossa (subhepatic fossa, right renal fossa) is seldom affected Of 10 abscesses in this situation, 1 was due to a gastric and 1 to a duodenal ulcer

Rarely the abscess involves the lesser sac (left posterior intraperitoneal, Barnard) of 3 cases of this nature it was due to perforated gastric ulcer in 2, but the lesser sac was not affected alone.

The abscess may burst spontaneously into a bronchus, into the pleura with the formation of a pyopneumothorax, into the stomach or intestine or rarely through the skin.

many cases, in diagnosing them from malignant tumours. The possibility of benignancy should always be considered in discussing the advisability of exploration in "advanced" malignant disease. The tumours may be divided into three groups —

1. Connective-tissue tumours.
2. Glandular tumours (adenomas).
3. Cysts.

I. CONNECTIVE-TISSUE TUMOURS

This group of tumours includes—i. Fibromas. ii. Fibro-myomas. iii. Angiomas. iv. Lipomas.

i. Fibromas

These are rarely met with. They may occur as polypoid tumours in the pyloric region, single or multiple. Specimens of these growths are shown in Fig. 336.

They may be encapsuled in the gastric wall, as in the case reported by W. G. Spencer in which he successfully removed a fibroma weighing 7 oz. from the posterior wall of the stomach of a woman of 46.




Fig. 336.—Fibromas of stomach.
(London Hospital Museum.)

According to Fenwick, no case hitherto recorded has been above suspicion of malignancy.

Treatment.—Pedunculated tumours should be removed by cutting through the pedicle and suturing the mucous membrane. When embedded in the gastric wall they should be enucleated, or excised with the affected part of the stomach.

ii. Myomas and Fibro-Myomas

These constitute the commonest variety of simple connective tissue tumour of the stomach; 61 cases (Thomson of Galveston) have been published since the first was recorded by Morgagni in 1762.

Arising in the muscular tissue usually along one of the curvatures, they are mostly single and may project into the stomach or grow externally; the internal and external varieties are about equally common. Those that project into the cavity of the stomach rarely attain a size larger than a walnut; they frequently become ulcerated, and may cause hæmatemesis or pyloric obstruction. The external form may attain a large size and may contract adhesions to various organs. Similar tumours may arise in the duodenum.

The condition is met with in adult life. Of 27 of the 40 cases analysed by Deaver and Ashurst, in which the sex was stated, 16 were females.

On section the tumour is firm and of a whitish colour and under the microscope is seen to be made up of bundles of unstriped muscle-fibres mixed with strands of fibrous tissue concentrically arranged.

Myxomatous degeneration may occur and cases have been recorded in which secondary growths were present in the liver and in the peritoneum. Cysts may originate from hæmorrhage. The tumour may contain angiomatous or adenomatous tissue.

Treatment.—When "internal" a myoma should be shelled out, or if this be impossible it should be excised, together with the portion of gastric wall from which it springs. When external, its pedicle should be clamped and divided, and the stump covered with peritoneum after ligature of the necessary vessels.

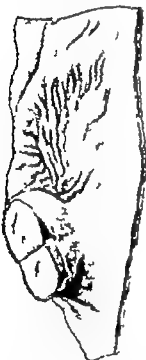


Fig 387 — Submucous encapsuled lipoma of stomach.

(*London Hospital Museum*)

iii. ANGIOMAS

Lemon has recently published an instance of this rare tumour in which a portion of the stomach was removed on the diagnosis of carcinoma. Five cases had been previously recorded.

iv LIPOMAS

Fatty tumours may originate in subserous or submucous coats, usually the latter and may in rare instances become pedunculated. They form lobulated tumours projecting into the stomach, covered as a rule by healthy mucous membrane (Fig 387).

2. ADENOMAS

Under this heading are included both the solitary and the multiple pedunculated tumours. The latter are usually called poly adenomas or mucous polypi (Fig 388)

Adenomas are ordinarily found in the pyloric region, and constitute the commonest variety of gastric polypi. The tumour may reach the size of an apple, and may produce pyloric obstruction, or cause fatal intussusception.

Multiple mucous polypi are more common in men than in women are rare before the age of 40 and are generally found in conjunction with chronic gastritis. Rarely larger than cherries, they are evenly distributed over the stomach, and may extend into the duodenum. The greater part of each polypus is composed of mucous membrane in which the glands are dilated and tortuous while frequently they are cystic.

Treatment follows the lines laid down for pedunculated tumours elsewhere.

3 CYSTS

Cysts of the stomach are rare. They may occur in consequence of injury (traumatic cysts), or as the result of degeneration of tumours (degeneration cysts); hydatid cysts may develop in the wall of the stomach. *Retention cysts may arise from* the obstruction of ducts in chronic gastritis, but they are devoid of clinical importance. *Gastric cysts produce symptoms* which resemble those of other benign tumours, but in addition they are liable to rupture or to become infected, causing a perigastric abscess or general peritonitis.

Symptoms of benign tumours.—In many cases benign

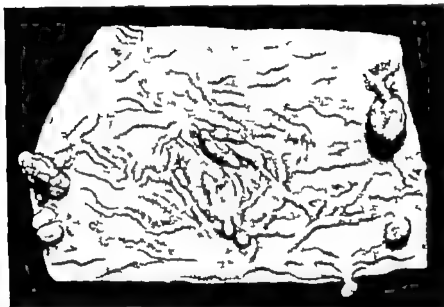


Fig. 388.—Mucous polypi.
(*Royal College of Surgeons Museum.*)

tumours give rise to no *symptoms unless they obstruct* the pylorus or the cardiac orifice but if large and situated in the body of the stomach they may cause pain of a dragging character Vomiting is unusual unless the tumour obstructs the pylorus. Hæmatemesis may arise in adenomas, angiomas, or myomas when the mucous membrane covering them has become ulcerated.

Diagnosis of benign tumours.—The possibility of a gastric tumour being benign should never be forgotten, for unnecessarily severe operations have been performed—for example partial gastrectomy for myoma.

MALIGNANT TUMOURS

CARCINOMA OF THE STOMACH

The stomach is the *most common site in the body for carcinoma* it is a disease of appalling frequency estimated to be the cause of death in over 4 000 people in England annually One-third of all carcinomas in men and one-fifth in women are in the stomach.

Etiology—Carcinoma of the stomach may be met with at any age, but is most common between the ages of 40 and 60 Thus, in 292 cases of carcinoma of the stomach operated on by the writer to June, 1921 two-thirds were between those ages. It is rare under 20—according to Osler and McCrae, 2 5 per cent. but among my cases the youngest was 20 and none of those operated on at the London Hospital was below this age. *Six cases* have been reported in children under 10 but of these only 2 can be definitely claimed as examples of carcinoma.

Sex—*Men are affected more frequently than women* thus, of 292 operated on by the writer only 94 were women.

Race.—As with chronic gastric ulcer the incidence varies in different races, being more common in the highly civilized. Bainbridge has stated that the black races are almost immune, and cancer of the stomach is said to be practically unknown among the natives in Natal, Gambia, and West Africa.

Gastric ulcer—It is held by all surgeons who have worked at the question that chronic gastric ulcer predisposes to the development of gastric carcinoma. The evidence may be looked at from two stand points—the clinical, which is circumstantial and the pathological which is *direct.*

Dealing first with the *clinical* it must be remembered that the preoperative diagnosis of chronic gastric ulcer is difficult. Carcinoma of the stomach resembles chronic simple ulcer in that it is more frequently found in men than in women, and the seat of election of the growth is similar to that of chronic ulcer While there has been great difference of opinion surgeons as a whole are convinced that the clinical evidence is, to say the *least, suggestive.* In 45 per cent. of my cases I found a history of over four years duration, sufficiently clear to have warranted a clinical diagnosis of chronic gastric ulcer *requiring operation* C. H. Mayo considers ulcer the most important factor and found a history of it in well over 40 per cent. Moynihan, in more than half the cases, found a history which was suggestive of previous chronic ulcer Pauchet puts it as high as 75 per cent.

From the *pathological* standpoint the possibility of carcinoma arising from simple ulcer was discussed as far back as 1839 by Cruveilhier In 1848 Dittrich, *in 160 cases of new growth, found 11 in which*

carcinoma developed in the immediate vicinity of active or healed ulcer Brinton in 1856 recognized this possibility

The most convincing evidence of the relationship of chronic ulcer and carcinoma we owe to work done at the Mayo Clinic by Wilson, MacCarty Broders, and MacDowall, published from 1909 onwards. At no clinic has so large a number of cases of chronic ulcer and of carcinoma been examined. The conclusion arrived at in these researches was that gastric cancer rarely develops except at the site of a previous ulcerative lesion of the mucosa.

Moynihan has found that, in 25–30 per cent. of the cases of carcinoma of the stomach removed by operation, the claim that the malignant change is imposed upon a simple one appears on pathological grounds to be irrefutable, and also that in not less than 10 per cent. of cases of gastric ulcer to all appearances simple, microscopic examination of the specimen removed at operation reveals the early stage of carcinoma. My figures agree closely To the end of June, 1921 in 22 out of 69 specimens of carcinoma of the stomach removed at operation there was definite microscopic evidence that the malignant disease started in a simple ulcer Among 165 ulcers removed during this period as simple ulcer in which I had no suspicion of malignancy carcinoma was discovered beginning in the edge of the ulcer in 11

Deaver and Reimann, in examining 100 specimens of carcinoma removed surgically found that 38 per cent. had arisen from simple chronic ulcers.

There can, in my opinion, be no doubt that gastric ulcer is a predisposing cause of cancer of the stomach in a large proportion of cases, and is the only cause known at present.

Pathology —Carcinoma may start primarily in the stomach or affect it secondarily The secondary variety is comparatively rare and of little surgical importance it occurred in 7 per cent. of the 285 post-mortem examinations of cancer of the stomach recorded by Fenwick, and Hale-White states that it occurs in 6 to 7 per cent. of the cases. In other published series the percentage has been as low as 1 which is in agreement with experience at the London Hospital.

Secondary carcinoma arises most often as the result of *direct* extension from the pancreas, colon, or gall-bladder or from the œsophagus. In this group must also be placed those cases, by no means uncommon, following carcinoma of the breast. More rarely it arises as a metastasis.

Primary carcinoma of the stomach may be composed of spheroidal or of cylindrical cells either may undergo colloid degeneration. If the fibrous stroma is abundant, the adjective " scirrhus is applied

if small in amount the growth is known as a "medullary" or "encephaloid" carcinoma.

In spheroidal-celled carcinoma the cells resemble those of the gastric tubules; this variety is more than twice as common as the cylindrical or columnar-celled (Perry and Shaw Fenwick) and is the usual type of "malignant ulcer." "Colloid" carcinoma—the result of a mucoid or colloid degeneration which, though usually affecting the cells, may affect the stroma as well—is found in about 7 per cent. of cases. Neither form has a special preference for any portion of the stomach, but the columnar-celled variety is most common in the pyloric region, where it usually springs as a soft red fungoid growth. Either form may infiltrate the whole organ (a variety of "leather-bottle stomach") rendering it small in the spheroidal-celled variety, rarely diminishing its size in the columnar (Fig. 389).

Situation.—In 90 per cent. of the cases the cancer is situated in the pyloric portion of the stomach and in 75 per cent. on the lesser curvature. Next in order of frequency comes the posterior surface, with which, not uncommonly, the pylorus is involved, causing symptoms of obstruction. In about 4 per cent. the tumour starts on the greater curvature, and in a similar percentage on the anterior surface. At the pylorus itself, producing pyloric stenosis, carcinoma is not by any means common—about 7 per cent. of cases. The same infrequency applies to the cardiac orifice, only 3 per cent. of cases occurring there.

Growths are occasionally multiple; in most of the recorded cases they have been on opposed surfaces of the viscus.

Carcinoma commences in the deeper layers of the mucous membrane; if at the edge of an ulcer it is usually in the edge nearest the pylorus.

Method of spread.—This may be direct, in the stomach itself or to adjacent organs immediately or through adhesion; or indirect, by lymphatics, by blood vessels, or by transperitoneal implantation.

Cancer in the stomach tends to spread along the lesser curvature and, as first pointed out by Rokitansky, rarely affects the duodenum. Although Brinton found the duodenum involved in 10 out of 125 cases, this high percentage has not been borne out by later observers; thus, of 131 cases, Fenwick found this structure involved in 2 only. However, as the result of microscopical examination of 63 specimens removed by operation, Borrmann found the cut edge of the duodenum involved in 20. On the other hand, carcinoma of the cardiac end of the stomach frequently involves the œsophagus, and vice versa.

Growth extends in the submucosa early and widely, while the induration marks the limit of infiltration of the mucous membrane.

the growth extends in the submucosa for several centimetres beyond The area of involvement of the serous and muscular coat is always less. Adjacent organs may be directly affected, most frequently the pancreas, then the liver and colon rarely the spleen.

Adhesions are present in about 80 per cent. of cases at the time of death, and constitute an important method of spread.

Lymphatic spread.—The lymphatic system of the stomach has already been described (p. 316) In carcinoma of the pylorus and lesser curvature the lower coronary group of glands is first affected.



Fig 389.— Leather-bottle stomach.

(*Royal College of Surgeons Museum.*)

Occasionally a lymphatic vessel runs past this group of glands and terminates directly in one of the upper coronary set this is well shown in Fig 390 from a photograph of a portion of a stomach which I removed In carcinoma of this region the subpyloric glands are usually affected, and lymphatic vessels may run directly to the supra pancreatic glands and even to the biliary chain.

Dobson and Jamieson have drawn attention to the tendency shown by the glands associated with the right gastro-epiploic artery to extend into the great omentum, but there are no efferent vessels here that drain into glands other than those of the gastro-epiploic, subpyloric or splenic groups.

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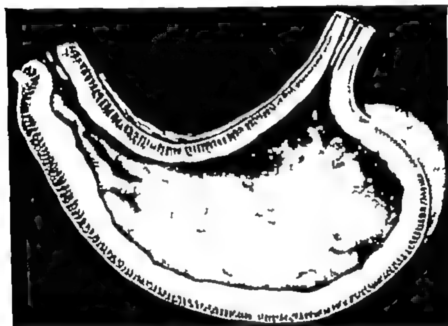


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are of great importance. Hæmatemesis of this nature in an adult should always raise the suspicion of carcinoma. In other cases the symptoms, according to the patient, follow an error in diet a short time before. But as a rule the onset is more gradual. As Brinton wrote An elderly person begins to suffer from a capricious appetite a distaste for food may be first noticed, perhaps a distaste for meat only This was at one time considered an important diagnostic point, but, although rarely absent in late cases, it is only exceptionally an early subject of complaint.

Pain is the most constant feature. It may not be so sharp or so localized as in ulcer is often not relieved when the stomach is empty and is seldom relieved by rest.

Vomiting may be absent or infrequent when the growth is prepyloric, and does little to relieve the pain it frequently occurs independently of food, is often offensive, and contains small quantities of blood. In growths causing pyloric obstruction vomiting is often the first symptom. Careful examination of the vomit will show the presence of *blood* in practically every case. *As a rule it is slight, and* may only be revealed by the test for occult hæmorrhage if greater in amount, it may impart a coffee-grounds appearance to the vomit. Bleeding sufficient to cause hæmatemesis is unusual Brinton estimated its frequency as 6 per cent. Fatal hæmorrhage occurs in not more than 1 per cent. of the cases.

When the growth is diffuse, involving the whole of the stomach (" leather bottle stomach) there is inability to take more than a certain amount of food without causing vomiting, and the amount that can be taken gradually diminishes.

A palpable *tumour* is present at some time during the course of over 70 per cent. of the cases but it must be remembered that it is a late sign. It has been stated (Czerny Rindfleisch) that the presence of a tumour means that the disease is inoperable. This is not so Instances have been recorded by the writer of patients alive and well thirteen and ten years after partial gastrectomy although a tumour had been palpable before operation. While the majority of *tumours are felt in the umbilical region, a tumour due to* carcinoma of the pylorus may be found in almost any part of the abdomen, while those due to growths of the lesser curvature and to leather bottle" stomach are seen in the epigastric and left hypochondriac regions.

Inspection of the abdomen will often reveal the tumour moving on respiration. Tumours of the pylorus can usually be moved from side to side, and vary in the position they occupy according to the condition of the stomach. Many receive transmitted pulsation from the aorta. Very rarely indeed the patient comes under observation because the tumour has been noticed and no other signs are present.

In some cases, as first pointed out by Wickham Legg in 1880 metastases are seen at the umbilicus.

Anæmia, loss of weight, and change in gastric secretion are other symptoms to be found in all late cases.

Anæmia.—In a few cases the resemblance of the symptoms to those of pernicious anæmia has led to error of diagnosis and treatment, but examination of the blood will prevent this mistake. The blood changes in carcinoma of the stomach are those of a secondary anæmia. The red corpuscles are rarely reduced lower than 3,000 000 the average of 59 cases recorded by Osler and McCrae being 3 712,186 There is a slight leucocytosis in most cases. It has been stated by Müller that digestive leucocytosis is absent in carcinoma of the stomach. Very little reliance can be placed on this finding, for digestive leucocytosis is present in nearly half the cases examined (Osler and McCrae, Fenwick)

Progressive *loss of weight* may very rarely be the first indication of disease. This is an important sign in suspicious cases a steady loss of weight may have diagnostic significance.

Changes in gastric secretion are present in the late stages of the disease. Golding Bird, in 1843, pointed out that free HCl was absent in cases of cancer of the stomach. Among 495 cases published by various authors, free HCl was absent in 89 per cent. (Fenwick) This corresponds with the writer's experience in the last 75 consecutive cases of carcinoma arising in persons with a previously clear gastric history free HCl was absent and total acidity low in 65 in 5 cases gastric acidity was higher than normal, and in 4 of these the diagnosis of chronic duodenal ulcer was discussed.

It was pointed out in 1879 by Hauser and again by Rosenheim in 1888, that there may be little change in the gastric acidity in those cases in which the carcinoma supervenes on chronic gastric ulcer In the last 25 consecutive cases of this type that have been operated on by the writer, free HCl was only absent in 6 and in but 2 of these was the total acidity below 30

In the cases in which carcinoma develops without previous history of gastric trouble, the absence of free HCl is a sign of great importance. It should be remembered that it is due to concomitant chronic gastritis, as shown by Hammerschlag, who from the examination of mucosa removed from the stomach in cases of gastro-jejunostomy found that when free HCl was absent the specific glandular elements had disappeared and been replaced by cylindrical epithelium. It is therefore found in many other diseases, but particularly in chronic appendicitis and disease of the gall bladder It is not a pathognomonic sign of cancer

Fragments of growth, blood, sarcinæ, and the Oppler Boas bacillus may be found on *microscopical examination of the vomit.*

3 **Latent cases**—In some cases in which malignant disease of the stomach is latent, progressive loss of weight is the first sign of *its presence* *In other cases, ascites or a tumour due to* secondary growth is first noticed

Fenwick was able to collect from the records of the London Hospital, during the twenty years preceding 1902, 14 cases in which the presence of *ascites* constituted the sole indication of cancer of the stomach. In at least half of these there was no evidence to connect the ascites with a malignant growth of the stomach.

Cases with ascites fall into two groups—(*a*) those in which the ascites is the first symptom seriously to attract the patient's attention and (*b*) those in which, following indefinite abdominal symptoms, there is a sudden onset of acute pain and swelling Six cases have been under my care in all the ascites had been preceded by vague abdominal symptoms of which no notice was taken in 2 the onset of ascites was gradual, in 4 it was so acute that the diagnosis of a perforative lesion was made.

In cases in which *metastases* call attention to the disease the secondary growths are usually in the liver but a malignant ovarian tumour may be the first sign for which the patient comes under observation.

Perforation may be acute or subacute Acute perforation takes place in about 3 per cent. of cases, but occasionally a subacute perforation with the formation of a perigastric abscess occurs.

Fistula may open externally or into the colon, rarely into the duodenum (see p 417)

Thrombosis of veins may occur in the late stage. Trousseau wrote "Should you when in doubt as to the nature of an affection of the stomach observe a vein becoming inflamed in the arm or leg, you may dispel your doubt and pronounce in a positive manner that there is a cancer"

Fever is present in nearly a third of the cases at some period during the course.

Jaundice is stated to occur in 13 per cent. of cases (Fenwick) and is due to extension of the growth to the head of the pancreas or the pressure of enlarged glands in the portal fissure.

Examination and diagnosis.—It cannot too often be stated that every case of digestive disturbance arising in an adult must be *considered as possibly* due to carcinoma In the Mayo Clinic 95 per cent. of gastric cancers have given distinct röntgenological signs of their presence. The characteristic sign is the "filling defect (see Plate 91 Fig 3) When the X ray evidence is definite it is of great assistance, but *too much reliance must not be placed* upon it it should never be allowed to influence our judgment in

considering operation. Should clinical evidence point to growth operation should not be ruled out because X ray examination is negative, nor because the radiographer's report declares the growth to be inoperable.

All the signs which make for a positive diagnosis are late signs.

Every disease and condition which may cause digestive disturbance must be considered. *Disease of the gall-bladder appendicitis* and *chronic gastric or duodenal ulcer* may give rise to great diagnostic difficulties. The first two may set up symptoms resembling almost exactly those of carcinoma free HCl may be absent and total acidity low and I have published cases in which even the report of the bismuth meal was strongly in favour of malignant disease of the stomach.

Chronic gastric ulcer in elderly people may run a course indistinguishable from carcinoma, and diagnosis may be impossible until exploration or possibly partial gastrectomy has been done. When carcinoma supervenes on chronic ulcer there may be nothing in the history even to enable the diagnosis to be made.

A careful examination of the gastric contents should be made. In patients in whom carcinoma originates in a previously healthy stomach, free HCl is usually absent and the total acidity is low by the time they come under observation. Whether this obtains within a few weeks of the onset of the symptoms remains for further investigation.

When the malignant growth supervenes on a chronic gastric ulcer free HCl is usually present in about normal amount, and the total acidity corresponds.

It is evident that too much reliance must not be placed upon the result of gastric analysis, but taken with other symptoms, it is particularly helpful in those cases in which gastric symptoms appear for the first time in adults.

In every case the left supraclavicular region should be carefully examined for glandular enlargement, and the pelvis must be investigated per rectum for secondary deposits in the region of Douglas's pouch. It is not uncommon for deposits to be found in these regions when the condition appears otherwise to be operable.

All are agreed that exploration should be undertaken when any *suspicion* of cancer exists, without waiting for the diagnosis to be made certain.

When a tumour is present it must be diagnosed from tumour of the gall bladder and colon if other means have failed, distension of the stomach with air or X ray examination after an *opaque meal*, will in most cases enable this to be done.

The symptoms may mimic those of chronic duodenal ulcer in

everything except the remissions. These are the cases, previously mentioned, in which gastric acidity is increased. When symptoms suggestive of chronic duodenal ulcer arise for the first time after the age of 40 and there are no remissions, the cause is probably carcinoma of the stomach.

Even when the abdomen has been opened and the stomach exposed, it may be impossible to make the diagnosis of malignancy without microscopical examination. In recorded cases the condition has been diagnosed at the operation as carcinoma and treated by partial gastrectomy yet subsequent microscopical examination has revealed chronic ulcer only in others a supposed palliative operation has led to complete disappearance of the tumour and proved to be curative. Points to be considered are the appearance and feel of the ulcer its method of spread, and affection of lymphatic glands. In carcinoma of the stomach the peritoneum is usually thickened and opaque, small outlying patches of the same nature are seen, and the lymphatics are often marked out. The shaggy red-stippled appearance of the peritoneum and the thickening with a depressed centre, seen in chronic gastric ulcer are rarely present. On palpation, distinct irregular induration may be felt. If there is doubt, the growth should be treated as malignant The removal of a portion for rapid histological examination is not conclusive.

Treatment.—The treatment of suspected carcinoma is surgical if the question that a growth is present is raised, valuable time should not be wasted There is only one safe rule every case of digestive discomfort arising in an adult who has previously been in good gastric health must be looked upon with suspicion. The first thorough examination will find or eliminate obvious causes, such as bad teeth, over work alcoholism, disease of the genito-urinary or nervous systems and the patient must be weighed. It is not humanly possible to examine by test and bismuth meals every case of this nature, but in those in which thorough examination has revealed nothing to account for the symptoms these investigations should be made at once. In the remainder the apparent cause should be treated for a month. If at the end of that time the patient is not well or sooner if he is not improving, test and bismuth meals should be given. In this type it is usual to find that free HCl is lost early and that the total acidity is low I consider this sufficient evidence to justify operation if we wait for absolute certainty we shall usually intervene too late. If an adult previously in good health develops discomfort after food for which no cause can be found, and the test meal reveals an absence of free HCl and a low total acidity operation should be carried out without delay

The percentage of cases suitable for resection varies in every

clinic, but should become greater as time goes on. As an average the following may be given In my series of 292 cases, 71 were treated by partial gastrectomy at the Mayo Clinic, 736 out of 2 091 at the Surgical Hospital at Lund (Borelius) 147 out of 501

Operation should be undertaken in all cases of suspected or proved carcinoma of the stomach, unless obviously inoperable by reason of secondary growths, the surgeon being prepared to do a partial or a complete gastrectomy

The surgical treatment can be summed up shortly The operation of choice is partial gastrectomy in certain cases total gastrectomy may be necessary *Simple gastro-jejunostomy should only be performed when the growth is producing obstruction in other cases no good results* If cardiac obstruction is present gastrostomy may be done in certain cases jejunostomy may be advisable.

The incision should be made in the right paramedian line and the rectus displaced outwards. If doubt exists, it is wise to treat the lesion as if it were malignant and perform partial gastrectomy

If the growth is obviously malignant its operability must be settled. The decision depends upon the presence and degree of adhesions and infiltration of other structures, particularly the liver and pancreas of massive glandular enlargements, and of secondary deposits in the peritoneum or at a distance. In every case a careful examination should be made before this question is decided. If from the presence of adhesions it is impossible to make out the nature of any tumour present, gastro-jejunostomy should be performed, and a further operation undertaken after the lapse of a fortnight If the mass has been due to chronic ulcer great improvement will have taken place in all probability the tumour will have almost completely disappeared, or even if it be carcinomatous, the subsidence of the coincident inflammatory swelling will have made operation easier

If advanced pyloric obstruction has produced a greatly dilated stomach and the condition of the patient is precarious, gastro-jejunostomy should be performed in such a position that it can be utilized when partial gastrectomy is carried out fourteen days later But as a rule, two-stage operations should be avoided.

The death-rate of *simple exploration* without further interference is small thus, of 746 explorations at the Mayo Clinic, it was only 2 7 per cent.

Occasionally after an exploratory operation a period of improvement sets in and all symptoms disappear for a time raising a doubt as to the correctness of the diagnosis. Four such cases have been under my care.

When possible, *partial gastrectomy* should be carried out (p. 419) In a few cases it may be justifiable to excise at the same time a portion

of the liver where the pylorus has become adherent to it or where the growth has directly attacked it, or a portion of the transverse colon where this is involved.

Total gastrectomy is rarely necessary except in cases of diffuse growth— leather bottle" stomach.

With regard *to the immediate mortality* At the Mayo Clinic 736 resections were carried out, from October 1897 to January 1919 with a death rate of 13 7 per cent. The writer has performed partial gastrectomy for carcinoma in 84 cases, with 6 deaths. The results are steadily improving, and at the present time the mortality should not exceed 10 per cent. and in the later cases at the Mayo Clinic has been 7 per cent.

The remote results are equally encouraging Of the writer s cases, 21 are free from recurrence more than three years after operation 3 after more than ten, 4 after more than six, and 1 died of another cause seven years later Of the cases operated on at the Mayo Clinic, 37 8 per cent. were alive and well three years, and 25 per cent. more than five years, after operation

The average duration of life after partial gastrectomy in cases in which recurrence takes place is about eighteen months. The quality of the life is good, and death occurs less painfully Recurrence is rare after two years if life is prolonged beyond four years, there is a good prospect of cure. From the collected statistics of Paterson 15 per cent. of the number operated upon lived five years or more. In 140 resections of stomach for carcinoma recorded by Kocher (1910) 20 per cent remained well for over four years.

At the present time it is safe to say that the general operative mortality is about 10 per cent. of the 90 per cent. who recover over a third will survive more than three years, and nearly a third more than five. These figures will show even greater improvement in the future.

Gastro-jejunostomy should be performed for the relief of symptoms when obstruction is present The death rate in these cases is considerably higher than when the operation is performed for simple diseases, and equals that of partial gastrectomy

With regard to the duration of life this cannot be predicted The average appears to be about six months, but the operation must be done only in the cases stated. The longest duration in my cases was two years, with absolute comfort for twenty-two months another lived fifteen months, with comfort for thirteen a third nine months with comfort for eight whilst in the others death took place within *six months* but the relief afforded by the operation in all made it worth doing Unless the growth is causing pyloric obstruction relief of symptoms is not obtained.

The radical treatment of carcinoma of the *cardiac end of the*

stomach is at present in the experimental stage. The researches of Sauerbruch, Willy Meyer Janeway and Green Meltzer and Auer Brauer and others have raised hope that it may be possible to extend *operative interference* to this portion of the stomach. Three cases have been recorded in which operation was carried out, the growth being removed and œsophago-gastrostomy done (Wendel, Wiener Janeway and Green) death occurred from secondary hæmorrhage in the first case, in the second from subphrenic abscess twelve days after operation and the third died fifty four hours later with an empyema.

Gastrostomy may be considered when it becomes impossible to take food, but should not be pressed. The immediate mortality is not high, and an interval of comfort of from three to six months, in some cases as long as eighteen, is given.

Jejunostomy is an operation rarely advisable for carcinoma of the stomach, though it may be performed to obtain relief from pain and vomiting. Patients seldom survive operation longer than a few weeks. The immediate mortality in 127 cases of jejunostomy collected by Billon was 29 per cent. and the majority of patients succumbed under two months only one lived for a year

CARCINOMA OF THE DUODENUM

In comparison with carcinoma of the stomach, this is a rare disease, notwithstanding the fact that chronic duodenal ulcer is more common than chronic gastric ulcer Maydl and Schlesinger found that it represented 2 per cent. of the primary malignant growths of intestine.

It affects men more than women, and is most common between the ages of 40 and 50. It may originate in a chronic ulcer Jefferson, in publishing a case of his own, was only able to collect 30 in which there was a possibility that the condition followed simple ulcer In more than half of these the evidence is not sufficient to justify the conclusion.

Cancer most frequently arises in the second part of the duodenum. In 41 cases collected by Rolleston, 24 had their origin here, 8 in the first part. Of 12 cases subjected to operation by the writer in one it was in the first part, in 6 in the second, and in 5 it was in the third, close to the duodeno-jejunal flexure. It may be secondary to carcinoma of the pancreas, of the gall bladder or bile-ducts.

The growth is usually cylindrical-celled, and has a constricting effect, like a similar growth elsewhere. When composed of spheroidal cells it forms a soft, flat mass or a deep fungating ulcer Colloid degeneration may occur

Symptoms.—These vary with the portion of the duodenum involved.

1 In the **supra ampullary** variety the symptoms resemble pyloric carcinoma and may very rarely follow those of chronic ulcer

A fixed or only slightly mobile tumour can sometimes be felt in the right hypochondrium.

2 Carcinoma in the **peri ampullary** portion most often arises in the mucous membrane covering the biliary papilla Usually, owing to the involvement of the papilla, jaundice is present (in 23 out of 25 of Mathieu s cases) it is often intermittent, thus differing from that due to carcinoma of the head of the pancreas or of the common bile-duct.

Painless jaundice is usually the first symptom, and is followed by gastric symptoms due to dilatation. The gall bladder is usually distended, and occasionally a fixed tumour can be felt in the right hypochondrium near the middle line

Not infrequently infection and suppurative cholangitis occur

3 In the **infra ampullary** cases the stomach and duodenum are dilated and the symptoms resemble those of pyloric obstruction, but with one important difference, viz. that the vomit always contains bile and pancreatic juice. The latter can be demonstrated by the digestion of fibrin after a few grains of sodium bicarbonate have been added to the filtered vomit. Intermittent attacks of intestinal obstruction are also common.

Prognosis.—The average duration of life is about seven months (Fenwick) Hæmorrhage, perforation, abscess, external or internal fistula, may complicate the course of the disease.

Treatment.—Palliative treatment is frequently all that is possible. In most cases this will consist in gastro-jejunostomy but in cases of carcinoma in the periampullary portion, when obstructive jaundice is present, relief may be obtained by cholecysto-gastrostomy When the growth involves the first portion of the duodenum removal together with the adjacent portion of stomach subpyloric and right gastro-epiploic glands, should be carried out. Carcinoma of the third part of the duodenum has been successfully removed by Syme. Hitherto operations for malignant growth of the second portion of the duodenum have been palliative only the growth being locally excised and the common bile-duct re-implanted Cases have been recorded—by Körte, in which the patient was alive nearly four years after the operation by Deaver in which the patient was alive and well one year after operation and by Czerny Halsted and W J Mayo in which the patient died a few days after operation. Radical operation in this situation will always necessitate removal of a portion of the pancreas in addition to the duodenum. The duodenum and head of the pancreas were first removed by Codivilla in 1898 gastro-jejunostomy and cholecystenterostomy being performed and the patient dying twenty four days later

Attention has again been directed to this possibility by the work

of French surgeons. Desjardins, in 1907 and Sauvé, in 1908 published suggested methods of operation, which, however had the same failing, that they were operations intended to be completed in one stage. As patients with obstructive jaundice stand prolonged operative procedures badly Kausch, in 1909 devised and carried out successfully a two-stage operation which is an advance in the surgery of this region. At the first operation the gall bladder was united to the jejunum and entero-anastomosis done below At the second operation performed after disappearance of the jaundice, a posterior gastro-enterostomy was made, the pylorus divided and closed, and the descending portion of duodenum removed. The common bile-duct was ligatured after as much as necessary had been removed a portion of the head of the pancreas excised, and the lower duodenal end then drawn over the stump. The case was reported a month after operation.

SARCOMA OF THE STOMACH

Sarcoma of the stomach is a rare disease, comprising about 1 per cent of all stomach tumours. It was first recorded by Sibley in 1816 Haggard in 1920, was able to collect 244 cases. It may occur at any age, but is most common between the ages of 30 and 60 The sexes are equally affected, except in fibro-sarcoma, which is more common in women.

The growth may be composed of round or spindle cells, and the intercellular substance may be very scanty or it may be definitely fibrous. Myomatous, myxomatous, or angiomatous tissue may be found in any given case.

The round-celled sarcoma is the most common type (60 per cent.) spindle-celled the next (36 per cent.)

Four types can be recognized (1) Round-celled sarcoma (2) Spindle-celled sarcoma (3) Lympho-sarcoma. (4) Secondary to sarcoma of retroperitoneal glands.

1 *Round-celled* sarcoma commences in the submucous tissue and may be diffuse or may form a circumscribed tumour projecting into the lumen of the stomach. It occurs most commonly in the pyloric region and along the greater curvature, but rarely gives rise to pyloric obstruction. The whole organ may be affected. Metastases are commonly present

2. *Spindle-celled* sarcomas, fibro-sarcomas, myo-sarcomas or endotheliomas usually form circumscribed tumours springing from the greater curvature and presenting a polypoid mass. They are all liable to myxomatous change and cyst-formation They tend to project towards the serous coat and may fill the greater part of the abdominal cavity

3 *Lympho-sarcomas* are composed of lymphoid cells in a fibrillar

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3 *Lympho-sarcomas* are composed of lymphoid cells in a fibrillar

meshwork (Kundrath, *see* Fig 391). Originating in a lymph follicle of mucous membrane, or a lymphatic gland in the pharynx or any part of the intestinal tract, they may spread along the wall of these tubes and bring about dilatation of the lumen. In some cases polypoid submucous growths are present.

In the stomach they originate in the submucous tissue, and may spread throughout the intestinal tract, thus differing from round celled sarcoma, which is confined to the stomach.

The growth, although commencing in the submucous tissue, infiltrates all the coats of the stomach and thus causes marked increase in thickness of the wall in the case described by Salaman it measured at one place 1½ in According to Salaman, 12 cases of this nature have been recorded. Some of these tumours have been described as lymphadenomas of the stomach, a condition which, if it occurs at all is very rare.

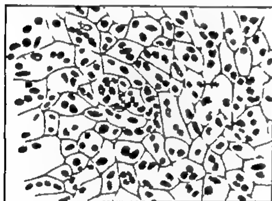


Fig 391 —Lympho-sarcoma (Kundrath's type) (*Salaman Prec. of Path. Soc.*)

4. *Secondary to sarcoma of retroperitoneal glands* —The intestinal tract is never or rarely affected in true lymphadenoma. It is well known that, in lymphadenoma in other parts of the body glands which for years have been clinically lymphadenomatous may coalesce and infiltrate the surrounding tissues. It is probable that the cases in which the stomach is involved secondarily to neighbouring glands are instances of this nature. (Fig. 392.) Many groups of glands and the tonsils are usually involved Salaman collected 8 cases and suggested the name lymphadeno-sarcoma for these growths.

Symptoms and diagnosis.—In the writer's experience the disease presents itself in two forms, corresponding to the exogastric and endogastric types into which Lecène and Petit divided it in 1901 In the former the symptoms are those of an abdominal tumour often without any digestive trouble. This type is more frequently found in women, and operation has been undertaken on the diagnosis of ovarian tumour The tumour may reach a large size the writer successfully removed two of this type, one of which weighed 6½ lb

In the other group the patient comes under observation on account of symptoms suggestive of carcinoma there is usually nothing in

the history in the X ray examination after an opaque meal or in a test meal that will enable the diagnosis to be made. Douglas states that in sarcoma free HCl is apt to be present in the gastric contents. In two cases of this type operated upon by the writer free HCl was present, and in both the total acidity was increased. Cases of this nature are too few in number to justify a dogmatic statement, and it is to be remembered that free HCl is by no means always absent in gastric carcinoma. The diagnosis is usually made at the time of operation from the appearance of the tumour occasionally

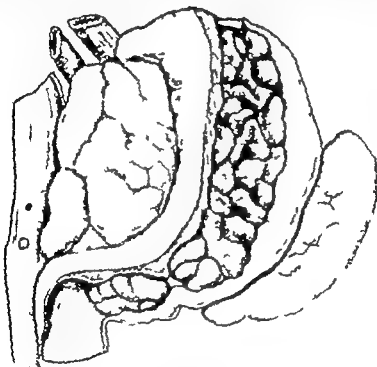


Fig 392.—Secondary involvement of stomach in 'lymphadenoma

(*Salaman "Proc. of Path. Soc."*)

as in the writer's two cases, only on microscopic examination. One was treated by excision and gastro-jejunostomy on the diagnosis of simple ulcer seven years ago the other by partial gastrectomy on the diagnosis of carcinoma two years ago both are alive and well, without sign of recurrence.

Prognosis.—The average duration of life is about 15 months in round-celled sarcoma, 28 months in spindle-celled. Death usually occurs from exhaustion. Perforation has taken place in 10 per cent. of the cases of round-celled sarcoma. The prognosis after removal

is less favourable than in carcinoma of the stomach, but patients are reported alive and well ten years after operation.

Treatment.—This is the same as for carcinoma. Of Haggard's collected cases, 107 were treated by operation.

Partial gastrectomy on the lines of that carried out for carcinoma is necessary in all cases of diffuse growth. In the pedunculated form removal of the growth with the portion of gastric wall from which it springs is all that is necessary.

Gastro-jejunostomy should be carried out when resection is impossible and pyloric obstruction is present.

SARCOMA OF THE DUODENUM

Primary sarcoma of the duodenum is extremely rare. As a rule it is round-celled, and involves the whole duodenum. Obstruction is rarely produced, the lumen of the gut being usually increased.

TUBERCULOSIS, SYPHILIS, FISTULÆ, ETC.

TUBERCULOSIS OF THE STOMACH

Tuberculosis of the stomach is usually secondary to tuberculosis elsewhere, most often in the lung, next in frequency in the intestines. After carefully reviewing all the recorded cases, Broders came to the conclusion that "no case of tuberculosis of the stomach has been absolutely proved to be primary in the stomach." Adults are more often affected than children, and males than females.

It is usually impossible to determine the mode of infection, which may be through (1) an erosion of the mucosa; (2) the blood stream; (3) lymphatics; (4) direct continuity of tissues (lymphatic glands).

Tuberculosis of the stomach presents two clinical types—(1) hypertrophic; (2) ulcerative. The latter is the more common. Thus, of the 306 cases collected by Broders which had been published as examples of this disease, in 49 the tubercle bacillus was demonstrated, and of these 81.6 per cent. were ulcerative; of 118 cases which he considered "probable" and which showed the histological features of tuberculosis, 80.5 per cent. belonged to the ulcerative type.

(1) The *hypertrophic variety* usually affects the pyloric region, and as in other parts of the alimentary canal, is frequently mistaken for carcinoma.

(2) A *tuberculous ulcer* usually occurs on the lesser curvature in the pyloric portion of the stomach, frequently runs transversely to the axis of the viscus, and may have all the characters of a tuberculous ulcer elsewhere.

The **symptoms** are variable. Perforation and hæmatemesis rarely occur In one patient a man of 34 who was under my care with a tuberculous ulcer of the anterior wall of the stomach the symptoms were indefinite and consisted of epigastric pain and vomiting without definite relation to food. In addition to the tuberculous ulcer of stomach, tuberculous peritonitis was present. Exploration was followed by recovery and the patient is in perfect health at the time of writing, thirteen years after operation.

Prognosis depends upon the presence and condition of tuberculosis elsewhere in the body

Treatment.—*Operation* should only be carried out to relieve pyloric obstruction, when gastro-jejunostomy should be performed. Otherwise the patient should be subjected to general treatment as adopted for tuberculosis elsewhere.

SYPHILIS OF THE STOMACH

Tertiary syphilitic lesions may be found in the stomach, but they are comparatively rare The *disease may be either congenital or* acquired but is usually the latter Smithies reported 26 cases in 7,515 patients suffering from all types of dyspepsia (0·3 per cent) Eustermann, ⅓ of 1 per cent of over 2,500 cases demonstrated at operation as ulcer at the Mayo Clinic. The disease begins in the submucous tissue and may be diffuse or localized Ulceration follows in both varieties the ulcers are usually multiple, associated with hyperplasia of the gastric wall and adhesions. *Deformity* commonly results, leading to stricture at the pylorus, in the body of the stomach, or at the cardiac end. Perforation may occur or a tumour may form, simulating carcinoma Of 12 cases observed by Bird, 11 were situated in the pyloric region.

Syphilitic lesions are usually present in other parts of the body and other visceral manifestations are common. The condition is *most often met with in males* between the ages of 25 and 50. Pain which is the most constant feature, is not related to the taking of food and vomiting is more frequent and persistent than in simple ulcer Free HCl is usually absent, and the total acidity low

Diagnosis.—There is no single symptom or combination of symptoms which will enable the diagnosis to be made from a chronic gastric ulcer or malignant growth. Syphilis should be suspected when gastric symptoms occur in a syphilitic patient. A positive Wassermann reaction with deformity of the stomach as seen on X ray examination after an opaque meal will help towards the diagnosis.

It must be remembered that gastric symptoms frequently arise in patients taking antisyphilitic remedies by the mouth, and that gastric syphilis is a late manifestation.

Treatment.—The usual antisyphilitic remedies should be given. If pyloric or cardiac stenosis is present, unaffected by drugs, gastro-jejunostomy or gastrostomy must be undertaken.

PLASTIC LINITIS (CIRRHOSIS OF STOMACH FIBROMATOSIS OF STOMACH—ALEXIS THOMSON)

This rare disease first named cirrhosis of stomach by Andral in 1845 was accurately described by Brinton in 1859 It is characterized by a diffuse fibrous thickening, usually starting at the pyloric region, chiefly involving the submucous coat, and diminishing the capacity of the stomach. There has been considerable discussion with regard to its etiology Early writers were of the opinion that the condition was simple. Doubt was thrown on this, however by Continental writers, and Rokitansky considered the cases atypical carcinoma, but the work of Alexis Thomson has proved that some of the cases are undoubtedly innocent. The condition is, however surrounded by difficulties, and it may be impossible, even after microscopical examination of the stomach or of the enlarged lymphatic glands, to say if the condition is simple (plastic linitis) or malignant (diffuse scirrhous carcinoma) for the section examined may show no sign of *malignancy but secondary deposits of carcinoma may be present* in the liver or the after-course only may render the diagnosis certain I have had 10 cases under my care in 5 the section of the stomach wall showed no sign of malignancy but in one of them secondary growths were present in the liver and in another the after course left no doubt that the growth was malignant.

The causation of plastic linitis is obscure when those cases secondary to diffuse atrophic carcinoma are excluded Thomson considers the fibromatosis to be the result of infection through an ulcer Of 9 of his specimens in which the disease was limited to the pyloric end in no less than 7 there was a visible punched-out ulcer situated in the centre of an affected area.

Syphilis and tuberculosis can be excluded as causes. The Wassermann reaction is negative, and examination of specimens has never revealed any appearance suggestive of tuberculosis.

Plastic linitis is a disease of adult life, more common in men than in women. The stomach is of normal size or contracted it may be freely mobile or fixed by adhesions externally it presents a peculiar pearly white appearance. On section it is found to be of diminished capacity and all its coats stand out (see Fig. 389) The thickening chiefly affects the submucous coat, which is many times the normal thickness. The mucous membrane is not usually affected, but may be ulcerated. The change is, as a rule, most pronounced in the pyloric region.

Symptoms.—As pointed out by Brinton the condition may be found after death, no symptoms having been produced during life.

It is a disease of insidious onset, with pain and vomiting The patient loses weight, and a tumour is usually found extending from under the left costal margin. Rarely free fluid may be present in the peritoneal cavity Free HCl is commonly absent from the gastric contents after a test meal.

Diagnosis.—This should be suggested by a tumour under the left costal margin, but no tumour may be felt. Complaint of inability to take the normal amount of food, and the frequent vomiting which is usually a characteristic, should lead to suspicion of this disease. Diagnosis may be confirmed by X ray examination after an opaque meal.

Treatment.—When possible, gastrectomy complete or partial should be done for it is impossible to be certain whether the condition is simple or malignant. Where this treatment is not feasible, gastrojejunostomy should be performed if the condition of the stomach will permit. One of the writer's patients lived in comfort for six years, and died of carcinoma of the liver

PHLEGMONOUS GASTRITIS (SUBMUCOUS GASTRITIS SUPPURATIVE LINITIS)

This is a rare condition of diffuse inflammation of the submucous layer of the stomach, occasionally going on to suppuration.

Since the recognition of the disease by P Borel, in 1656, the number of recorded cases is about 215 The condition is more common in men than in women, and may occur at any age, but is most often seen between 20 and 40. In 25 per cent. of the cases there is a history of chronic alcoholism

Etiology and pathology—Phlegmonous gastritis is an infective cellulitic inflammation of the submucous tissue of the stomach, which may diffusely involve the whole stomach or be localized (the latter in about 20 per cent. of the cases) The infecting micro-organism present is usually a streptococcus, but mixed infection with the colon bacillus is not uncommon. In a case recorded by J E. Adams a pure culture of pneumococcus was obtained. The organism may obtain entrance through an ulcer simple or malignant, or a wound, accidental or operative. In some cases the origin of the infection cannot be discovered in others it is associated with some acute infective disease such as typhoid or puerperal fever whilst cases have been recorded following the ingestion of infected food. There are, therefore two groups—primary in which the infection occurs through a lesion of the stomach wall and secondary complicating other diseases. J E. Adams suggested that the term primary should be applied only to those cases in which no naked

eye lesion of the gastric wall can be discovered secondary to those in which the infection spreads from an ulcer, simple or malignant, or from an operation wound. But as it is probable that in all, except *those complicating disease elsewhere, the micro-organism gains* entrance through the wall of the stomach, the term primary should not be limited to those in which the seat of entrance is visible to the naked eye.

The stomach wall is increased in thickness, often to eight or nine times its normal size. The peritoneal coat in the early stage is unaltered but in the later stage shows signs of inflammation. The mucous membrane is swollen and often hyperæmic and ecchymotic. The submucous coat is much thickened, yellowish-white in appearance, and soft, and occasionally presents tiny abscesses. Peritonitis is found in most of the cases. When the disease is circumscribed the pyloric end is most often affected, and a localized abscess may form.

A similar condition may occur in the duodenum. Ungermann has collected 6 cases of phlegmonous duodenitis, in 3 of which the disease was localized in the duodenum alone. The inflammation was most pronounced in the region of the biliary papilla.

Symptoms.—The onset is usually sudden with severe epigastric pain, vomiting, and prostration. The pain is constant, and accompanied at first by localized rigidity. The patient is obviously suffering from some acute septic condition the pulse is feeble, the temperature is elevated, and the tongue is dry and furred. Later the signs of general peritonitis are added.

Prognosis.—No case of generalized phlegmonous gastritis has recovered. In a case of the localized variety in which a definite abscess formed, recovery followed operation and evacuation of the abscess, and also partial gastrectomy spontaneous recovery has followed rupture of the abscess into the stomach, the pus being vomited.

Diagnosis.—This has, so far never been made before operation and when one considers that it has to be made from a perforative *lesion of the stomach or duodenum and from acute cholecystitis or* pancreatitis, it is unlikely that it will often be possible. The history of alcoholism, the frequent vomiting, and the profound general disturbance should cause the condition to be suspected.

In the localized form after an acute onset the symptoms abate and a swelling palpable through the abdominal wall may form. This may rupture into the peritoneal cavity causing general peritonitis, or into the stomach recovery has followed the latter accident.

Treatment.—In the diffuse variety if exploration is undertaken before general peritonitis has supervened, multiple incisions down to

the submucosa should be made after packing off the stomach area with gauze. In the localized form which is usually limited to the pyloric portion of the stomach, partial gastrectomy should be carried out.

GASTRIC AND DUODENAL FISTULÆ

Fistulæ connected with either stomach or duodenum are rare. The fistula may be an "internal" one connecting the organ with another viscus, or an "external" one opening on the surface of the body. Of gastric fistulæ, the internal is the more common; a duodenal fistula is much rarer and here the external fistula is more frequent than the internal.

Gastric Fistulæ

On account of the development of gastric surgery these cases are rarer now than formerly; external gastric fistulæ are particularly uncommon.

External Fistulæ

Fall into two groups, the traumatic and the pathological, the latter being divided into primary in which the causal disease originates in the stomach, and secondary in which it begins in a neighbouring organ. Liebiem and Hilgenreiner based their article in 1905 on 120 published cases. Formerly gastric ulcer was the most common cause; now it is rarely seen except in advanced malignant disease.

1. Traumatic.—Alexis St. Martin was the most celebrated example of this condition. Fistulæ rarely form nowadays as the result of injuries to the stomach, immediate operation saving the patient from this risk. Cases have been recorded in which a foreign body swallowed has perforated the stomach, caused a perigastric abscess which has opened externally and thus led to a gastric fistula. A fistula occasionally follows operations upon the stomach and neighbouring organs and cases have been recorded following operations upon pancreatic cysts, cholecyst-gastrostomy, partial gastrectomy, gastro-enterostomy and nephrectomy.

2. Pathological. (*a*) *Primary*.—In both simple and malignant ulcers of the stomach, fistula may be a secondary result of subacute perforation, a perigastric abscess forming which is opened or bursts through the anterior abdominal wall. In a few cases the fistula may be the result of the direct involvement of the abdominal wall.

Cases have been recorded in which the stomach was contained in a strangulated ventral hernia and a fistula followed operation.

(*b*) *Secondary*.—These are usually due to disease of the liver and gall bladder; cases have also been recorded after operation upon hydatid cysts of liver, etc.

Symptoms.—The characteristic feature is the discharge of stomach contents from an opening situated in most cases in the lower epigastric region the umbilical region, or the left hypochondrium. If the discharge is small very little effect is produced on the general condition of the patient if it is great, the patient wastes and much discomfort is caused by irritation of the skin

The **diagnosis** may have to be made from duodenal fistula this is usually easy from the position of the external opening, and is facilitated by noting the characters of the discharge and the lapse of time between ingestion of food and its appearance at the opening In a gastric fistula food generally appears within a short time of ingestion, while delay occurs in duodenal fistula and the discharge is often bile-stained.

Prognosis.—This depends upon the causation. Patients have lived as long as thirty five years after the formation of the fistula. If the pylorus is unobstructed and the fistula not large, spontaneous healing will occur thus, it takes place in most postoperative cases and in those following the perforation of ulcers on the anterior surface of the stomach.

Treatment.—Resort to operative treatment should not be hurried, unless the escape of gastric contents is great. In these cases, after packing the external opening with gauze and thoroughly cleaning the skin in its neighbourhood an elliptical incision should be made around it, the peritoneal cavity opened the fistulous tract dissected down to the stomach, and the opening closed. If the fistula is due to malignant disease, or the condition of the patient will not permit of extensive operation, jejunostomy may be performed. Where the condition is not interfering with the general health, it may be left in the hope that it will eventually close.

Internal Fistulæ

These may be the result of injuries (usually operative) or of disease, primary or secondary The communication is most frequently with the colon, more rarely with the gall bladder duodenum, jejunum lung, pancreas, urinary tract, or œsophagus.

Gastro-colic fistula is usually the result of carcinoma (65 out of 84 cases—Chavannaz), mostly of the stomach much less frequently of the colon. It may result from simple ulcer tuberculous disease of colon, perigastric abscess due to disease of neighbouring organs, or ulcer of the jejunum following gastro-jejunostomy (*see* p. 428)

The fistulous opening in the stomach is most common at the greater *curvature near the pyloric end that in the colon, in the middle of* the transverse part.

Symptoms.—The condition may exist without giving rise to symptoms, but in the majority of cases they are definite and consist of fæcal vomiting and diarrhœa, the motions containing undigested food, which in some cases appears soon after it has been taken In many cases a similarity between motion and vomit has been noticed Diarrhœa may be the only symptom.

Diagnosis may be confirmed by X ray examination after an opaque meal. No difficulty arises except in hysterical women.

Sir Frederick Treves recorded an example—a woman of 20 vomited formed fæces, and an enema of methylene-blue a few minutes after it was given at operation, all abdominal organs were normal. The patient had undergone two operations previously Similar cases have been reported by others.

No mistakes should occur if the existence of these cases is remembered, for they occur in well-nourished, hysterical women, whereas the patients with gastro-colic fistula are obviously ill.

Prognosis is bad when the fistula is a sequela of carcinoma.

Treatment will depend upon the causation. If this is malignant growth, wide dissection followed by end to-end suture of colon and partial gastrectomy (p 419) should be performed if possible. If the growth is too far advanced to admit of this, short-circuiting operations should be done. When the fistula is due to simple ulcer this should be treated on the usual lines after closing the communication with the colon.

Other kinds of Internal Fistula

Fistulous communications between the gall-bladder and biliary passages and the stomach or duodenum, although relatively rare, are after the gastro-colic, the most common form of gastric fistula. Cases have been recorded in which patients vomited gall-stones more often the fistulous communication is with the duodenum, and no symptoms result unless a stone passes into the intestine large enough to cause intestinal obstruction.

No symptoms appear unless there is coexisting pyloric or duodenal obstruction in these cases there may be vomiting of bile.

Treatment.—The gall bladder should be separated from the stomach and the opening into the latter closed The gall bladder should be removed and gastro-jejunostomy done if necessary

Duodenal Fistulæ

These, while very rare may follow operation upon gall bladder duodenum or kidney When the duodenum has been mobilized or the purpose of removing a stone from the retroduodenal portion of the common duct, a fistula may result. Fistula is not an uncommon sequel to the perforation of a duodenal ulcer it may follow

suture, the opening of a subdiaphragmatic abscess or of one due to retroperitoneal perforation. The external opening is usually in the right hypochondrium, but in the case last mentioned may be in the loin or even in the inguinal region.

Internal fistulæ have been described, the duodenum communicating with stomach or colon. These are pathological curiosities. The only common form is that between duodenum and gall-bladder secondary to disease of the latter.

Prognosis.—In the cases following operation the fistula usually heals spontaneously

Treatment.—The treatment is on the same lines as in external gastric fistulæ (p 416) If spontaneous closure does not occur or delay is inadvisable gastro-jejunostomy should be performed, with simultaneous closure of the pylorus.

GASTRIC OPERATIONS

General considerations.—Care must be taken to render the upper part of the alimentary tract as sterile as possible the mouth must be attended to and all septic teeth treated. For twenty-four hours before operation nothing but sterile milk or Benger's food should be given. If examination gave evidence of gastric stasis, the stomach should be washed out an hour before operation if dilatation is great lavage should be employed twice a day for several days before operation is undertaken.

The abdomen should be opened through a right paramedian incision, the rectus muscle being retracted outwards. In this way the incision may be enlarged to any extent that may be necessary without the risk of subsequent hernia formation. The whole of the stomach and duodenum must be carefully examined then the condition of other organs investigated (particularly the gall-bladder and appendix).

Nothing but catgut should be used for suture material. Unabsorbable suture (p 428) for the outer layer may give rise to trouble years later

After recovering from the effects of the anæsthetic the patient should be propped up in bed and nursed as far as possible in this position. When he is lying down the dorsal position is unnecessary and he may be turned from side to side as desired. Vomiting is unusual, and during the first twenty four hours the patient should be allowed to drink as much water as he wishes. On the day following operation, milk, Benger's food, bread and milk, and tea can be given at the end of a week, lightly boiled eggs and about the tenth day fish Food should be increased gradually For the first week or ten days the patient is better in bed, but he may be allowed up about the tenth day This rule may be broken without fear of evil conse-

quences, if confinement to bed is inadvisable, unless the wound has been allowed to remain open for drainage.

After all gastric operations the patient must be warned to be careful of his diet for at least three months, and to avoid alcohol.

GASTRECTOMY

Gastrectomy may be described under two headings, partial and complete. The term *partial gastrectomy* should be restricted to a definite operation, i.e. removal of the pyloric portion of the stomach together with the whole of the lesser curvature and a varying portion of the greater curvature, never less than its pyloric half When small portions of the stomach wall are removed the operation should be called resection In *complete gastrectomy* the whole of the stomach is removed from the duodenum to the œsophagus.

Partial Gastrectomy

In this operation, when carried out for malignant disease, in addition to the part of the stomach mentioned above, the primary lymphatic glands, the lesser omentum, and as much as possible of the gastro-colic omentum must be removed, together with about an inch of the duodenum.

In the early days of pylorectomy and partial gastrectomy direct union of the cut ends of the stomach and duodenum was carried out by the method devised by Billroth (Billroth I.) As this was found unsatisfactory in many instances, both cut ends were closed, posterior gastro-jejunostomy being carried out to the portion of the stomach left (Billroth II.) This was later modified by uniting the jejunum side to side with the cut end of the stomach (*see* Figs. 393 394) This modification of the Billroth II operation seems to have occurred to several surgeons. The writer who first carried it out in 1911 thought at the time that he was the first, but found later that Polya had published an account of six cases in which he had adopted this procedure This type of partial gastrectomy should be carried out whether the operation is performed for malignant disease or for its most common indication, chronic ulcer In performing the operation for malignant growth the lesser omentum is ligatured and divided close to the liver the operator then inserts his hand into the lesser sac so as to free the stomach, if necessary from the pancreas, and to separate the anterior layers of the great omentum from the transverse mesocolon. These are then ligatured and divided close to the colon. Care is necessary at this stage to avoid the middle colic artery Injury to this vessel has resulted in the death of the patient from gangrene and perforation of the transverse colon.

The duodenum is then crushed and cut through with the cautery and the stump closed. All the fatty tissue and glands in the angle between the stomach and duodenum must be removed.

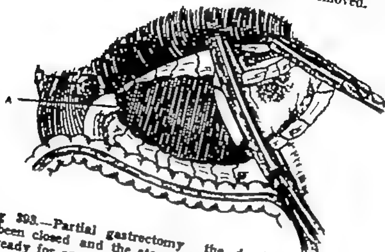


Fig. 393.—Partial gastrectomy: the duodenal end has been closed and the stomach turned over to the left, ready for anastomosis to the jejunum.
Duodenum closed.

The coronary artery is sought at its origin and divided, and all the tissue here removed down to the stomach: the stomach can now be pulled well over to the left. A portion of jejunum is then

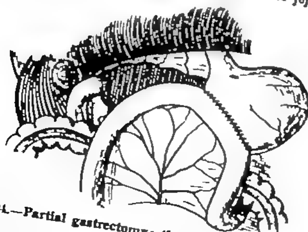


Fig. 394.—Partial gastrectomy: the operation completed.

brought and sutured to the stomach proximal to the line through which the section is to be made. The gut should be brought to the stomach in front of the colon and united with the efferent limb pass-

ing to the right or to the left, in whichever direction it lies without kinking When the transverse colon is dropped or the colon is large, the jejunum may be brought to the stomach through an opening in the mesocolon, which should always be sutured to the portion of stomach left.

It may be necessary to excise the whole or a portion of the transverse colon with the stomach either because it is invaded by the growth or because its blood supply is endangered

Complete Gastrectomy

The operation is begun as in partial gastrectomy but the entire gastro-colic omentum and then the gastro-splenic omentum are ligatured off. After division of the coronary artery the stomach can be pulled well out. It should not be removed yet, but a coil of jejunum brought up and united to the extreme cardiac end of the stomach by stitches passing through serous and muscular coats. An opening is then made in both, and gradually enlarged as stitches are put in through all the coats of each viscus, the stomach in this way being removed. Finally the operation is completed by the insertion of an anterior row of sero-muscular stitches or the jejunum may be divided completely its distal end anastomosed to the oesophagus, and its proximal into its distal portion.

GASTRO-ENTEROSTOMY

This operation consists in making an anastomosis between the stomach and the small intestine. The jejunum is usually chosen (gastro-jejunostomy) in a few cases the duodenum (gastro-duodenostomy)

Gastro-Jejunostomy

This may be performed to the anterior or the posterior surface of the stomach. The latter is the operation of choice.

Posterior Gastro-Jejunostomy

After careful examination of the stomach, the transverse colon and omentum are withdrawn from the abdomen and an opening made in the transverse mesocolon, beginning close to the point at which it is in contact with the jejunum. The duodeno-jejunal flexure is now carefully examined—the jejunum at its origin should always be seen (p 316) The opening should then be enlarged, care being taken to avoid injury to vessels. The portion of stomach wall which is to be used for the anastomosis is drawn through this opening and clamped in a vertical direction from the lesser to the greater curvature The jejunum is then stretched tightly from the duodeno-jejunal flexure and fixed to the stomach by two catgut sutures. A clamp should

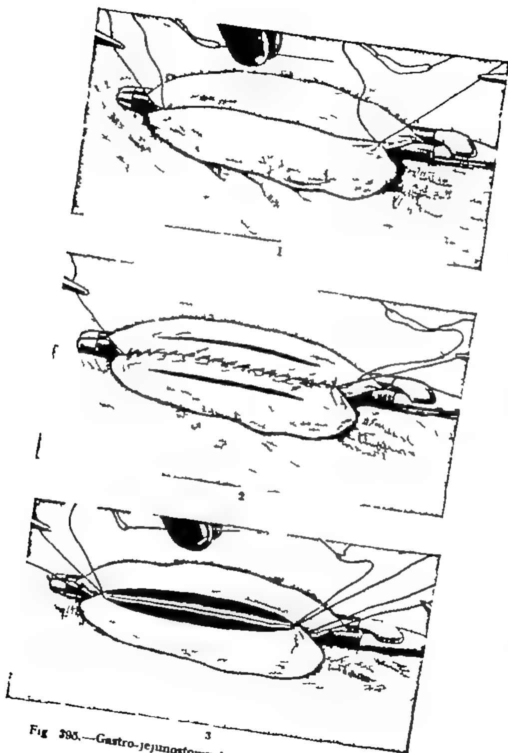


Fig. 395.—Gastro-jejunostomy by the four stitch method.
(See text p. 423.)

not be used on the jejunum. Care must be taken that the jejunum does not become twisted longitudinally. At least 3 in. of stomach should be in the clamp A strip of gauze should then be placed behind, and the omentum, colon, and rest of the stomach returned to the abdomen. In performing the anastomosis four stitches are used. The stomach and jejunum are first united by two passing through serous and muscular coats at least 3 in. apart (Fig 395) The suture at the patient's right is then taken, and a continuous sero-muscular stitch inserted from right to left When the left stitch is reached it is tied off, and its end tied to the loose end of the left stitch. The viscera are opened, and a stitch passed at each end of the opening through all the coats of the stomach and jejunum. The right hand needle is then taken and a continuous stitch inserted, care being exercised to pass the needle through all the coats and to insert them sufficiently closely to stop all bleeding Before commencing the anterior layer of through-and through stitches, the clamp on the stomach should be loosened and any bleeding-point secured. The left stitch is then inserted continuously from left to right and tied off. After removal of the clamp the sero-muscular suture is finished anteriorly

The posterior surface of the anastomosis is inspected by pulling on the gauze and finally the opening in the mesocolon is stitched to the stomach close to the line of anastomosis If the operation is performed in this way the results are most satisfactory

Anterior Gastro-Jejunostomy

This was the original operation performed by Wölfer in 1881 It should only be carried out when conditions render the posterior operation impossible. As usually performed it is a "loop" operation. A portion of the jejunum 18 to 24 in. from the duodeno-jejunal flexure is taken and brought up beneath and then in front of the transverse colon, and united to the anterior surface of the stomach. This loop is unnecessary and dangerous. Since 1904 I have always performed the anterior operation without a loop This operation is original, the nearest approach to it being the operation described by Brenner in 1891 in which the jejunum was brought to the stomach by the same route but a long loop was left. The duodeno-jejunal junction is found and an opening made in the transverse mesocolon and gastro-colic omentum immediately over it a portion of jejunum close to the duodeno-jejunal flexure is brought up through this and united to the anterior surface of the stomach (Fig 396). At the end of the operation the opening in the great omentum is stitched around the stomach (Fig 397)

I have performed this operation on many occasions, and have

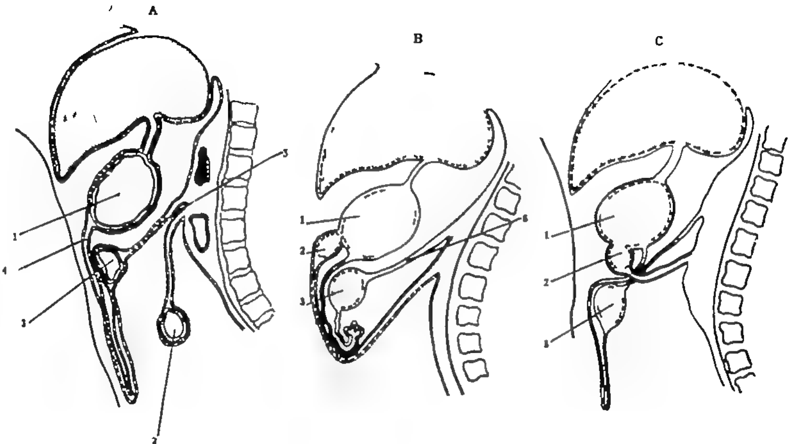


Fig. 396.—Anterior gastro-jejunostomy A, Normal relations. B, Old operation of anterior gastro-jejunostomy C, Author's operation.

1, Stomach; 2, jejunum; 3, transverse colon; 4, great omentum; 5, transverse mesocolon.

found convalescence as smooth as after the posterior no-loop operation, with absence of regurgitant vomiting The first patient upon whom I performed the operation for a saddle-shaped chronic gastric ulcer died of another cause twenty eight months later the ulcer was healed and the anastomosis was described by the pathologist as posterior

The three methods of gastro-jejunostomy are shown diagrammatically in Fig 398.

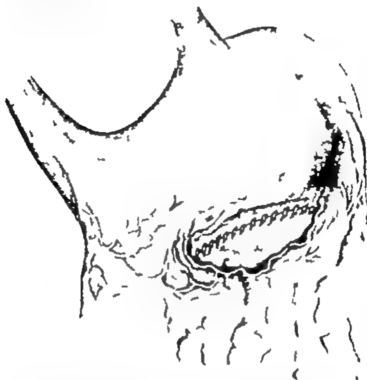
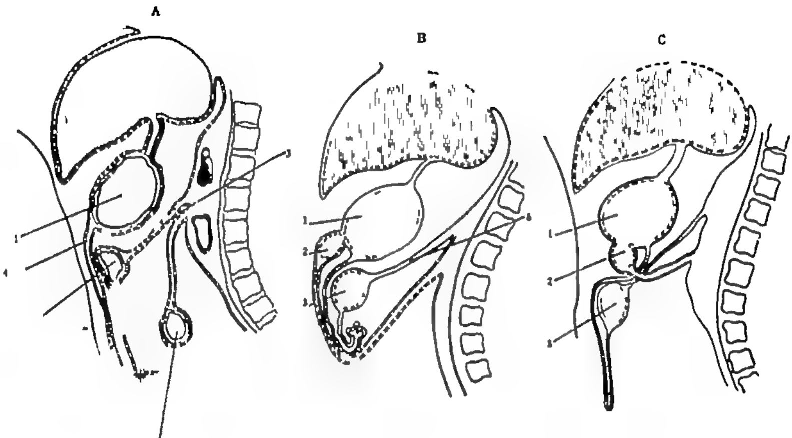


Fig. 397 —Anterior no-loop gastro-jejunostomy completed except for suturing the opening in the great omentum around the anastomosis.

Results of gastro-jejunostomy.—It is beyond dispute the performance of gastro-jejunostomy in suitable cases is fol by the healing of a chronic ulcer of the stomach or duodenum p 365).

After gastro-jejunostomy the total acidity of the gastric is lowered and free acidity usually abolished. This is due partly the escape of bile or pancreatic juice into the stomach, and also all probability as pointed out by Paterson, to the earlier secret



gastro-jejunostomy : A Normal relations. B, Old operation of anterior gastro jejunostomy C, Author's operation.

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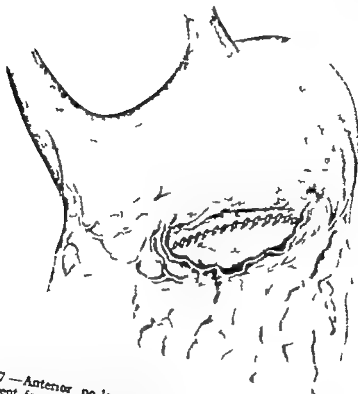


Fig. 397 —Anterior no-loop gastro-jejunostomy completed except for suturing the opening in the great omentum around the anastomosis.

Results of gastro-jejunostomy.—It is beyond dispute that the performance of gastro-jejunostomy in suitable cases is followed by the healing of a chronic ulcer of the stomach or duodenum (see p 365)

After gastro-jejunostomy the total acidity of the gastric contents is lowered and free acidity usually abolished. This is due partly to the escape of bile or pancreatic juice into the stomach, and also in all probability as pointed out by Paterson, to the earlier secretion

is truly regurgitant. Vomiting may begin from the seventh to the tenth day this is the type that is more often seen at the present time. As a rule it yields rapidly to gastric lavage, but may continue unchecked until relieved by operation.

In severe cases, large quantities of bile-stained fluid are vomited *once or twice a day The vomit gushes up with very little effort,* and as a rule contains no food. Emaciation is rapid and death occurs unless relief is given.

In less severe cases, vomiting of a similar nature occurs at irregular intervals In still slighter cases there is regurgitation of small quantities of bilious fluid. In the slight cases the patient may put on weight and obtain complete relief from the symptoms for which the operation was performed. It is very unusual for the vomiting to appear after the second week, but cases have been recorded in which it first occurred many months after operation.

Treatment.—Lavage should be employed once or twice a day and continued until the passage of the stomach tube reveals no excess of fluid in the stomach. In the severe cases coming on soon after operation, if lavage does not speedily relieve, further operation must be undertaken. If a loop has been left, it is usually found distended. *Entero-anastomosis between the afferent and efferent limbs should* be performed or the afferent limb divided and implanted into the efferent below the anastomosis (Roux's operation) It may happen that neither is possible, there being no loop in these cases entero-enterostomy should be carried out by the method employed by Finney for gastro-duodenostomy (p 433) or a communication made with the second part of the duodenum. The latter is necessary when the obstruction is due to the pressure of the superior mesenteric vessels.

If the operation was performed for symptoms only and no lesion of stomach was found the anastomosis should be excised and the continuity of intestine re-established

3. Secondary ulcer.—*Ulceration* of the jejunum after gastro-jejunostomy is an uncommon condition. It was first described by Braun in 1899 One of the most important contributions to the subject was made by Paterson ten years later In addition to reviewing the cases recorded to date (52 certain and 11 doubtful) he suggested the classification into jejunal and gastro-jejunal (anastomosis) ulceration this is important, as the causation of the two types differs.

It is impossible to estimate the frequency with which this complication is met with, as it must vary with the type of operation and nature of the suture material (*see* p. 418). Paterson's original estimate was 1 to 2 per cent. Judd, reporting on cases from the Mayo Clinic found about the same proportion, and this has been the experience *of the writer*

Causation.—The complication usually follows gastro-jejunostomy performed for chronic ulcer of the duodenum or stomach, but has been recorded (Moynihan, Mayo Clinic) after gastro-jejunostomy carried out when no ulcer was present. It has been met with after all forms of gastro-jejunostomy anterior and posterior with or without a loop and after entero-anastomosis and en Y (Roux's operation) Its frequency after the anterior operation is undoubted. The Billroth II type of partial gastrectomy for chronic gastric ulcer is not exempt from this complication (Eiselsberg, Baum) but it has not been recorded after the Polya type. It is more frequently met with in men than in women and after operations for duodenal than for gastric ulcer thus, in the writer's experience of 34 cases, 32 were male and in 30 the original operation was for chronic duodenal ulcer This sex relationship is very striking, and has been noticed by all who have written on the subject. Thirteen of the ulcers were true jejunal all occurred in men, and all except one after operation for duodenal ulcer It seems obvious that there must be some factor acting in men, and in cases of duodenal ulcer, which is not present to the same extent in women and in patients with chronic gastric ulcer This factor is the degree of gastric acidity Gastric acidity is lower in women than in men and in gastric as compared with duodenal ulcer Thus, in 50 consecutive cases of duodenal ulcer treated by operation the average was—in men, 0·10 (free HCl) and 53 (total acidity) in women, 0·07 and 45 Test-meals were given in 29 of the 34 patients. Both free and total acidity were raised in 14 in 10 gastric acidity was normal, but it must be remembered that a normal gastric acidity after gastro-jejunostomy is itself abnormal. Of these 10 only 4 were jejunal, and in 2 the ulcer communicated with the colon. Of those with lowered acidity 2 had progressed to jejuno-colic fistula and 3 were anastomotic ulcers in which the acidity although low was the same as before operation. Pyloric exclusion is an important cause in the prevention of postoperative lowering of acidity In 13 out of 14 cases of true jejunal ulcer which I have operated on, pyloric exclusion had been carried out. Carman writes of experience at the Mayo Clinic "There were 1 1 per cent. of the total number of posterior gastro-enterostomies that developed gastro-jejunal ulcer a very small percentage when the frequency of the operation is considered. When the pylorus was blocked this percentage was increased to 5 per cent. There was also a slight rise in those cases in which perforation had occurred, 1·5 per cent. Haberer records that after 265 cases of gastro-jejunostomy there were 3 ulcers, but in 71 in which the pylorus was excluded in addition there were no less than 14 Finsterer reports 7 jejunal ulcers after 43 cases in which pyloric exclusion was added to the gastro-jejunostomy

All writers following Paterson appear to agree that hyperacidity is the most important cause. Various contributory causes have been suggested from time to time. Bruising of the jejunum by clamp or the formation of a hæmatoma is undoubtedly one factor I have noted this in 6 cases. In 3 gastric acidity was not effectually lowered by the gastro-jejunostomy and secondary ulceration occurred in all. In the other 3 acidity was so greatly lowered that the after history has been uneventful and jejunal ulceration is not to be feared. Failure to deal with the original infection is an important factor syphilis has been suggested (Erdmann) A characteristic of true jejunal ulcer has been its liability to recurrence, suggesting that a failure to deal with the cause is a substantial etiological factor In 4 of the writer's cases that died, post mortem examination revealed tuberculous lesions in kidney and lungs in 3 in the other rheumatic endocarditis.

That unabsorbable sutures are the usual cause of the gastro-jejunal or anastomotic ulcers is now accepted. They may as suggested by Garnett Wright, also occasionally be responsible for the formation of a true jejunal ulcer by the irritation of a loose end.

When occurring in the jejunum the ulcer is usually solitary resembling that met with in the stomach and duodenum. As a rule it is situated on the anterior surface of the jejunum, about ½–¾ in. from the anastomotic opening, resembling in its usual site a duodenal ulcer Gastro-jejunal ulcer may be single or multiple, and in its typical form it is a cup-shaped cavity at the bottom of which is a tiny opening from which a portion of suture is seen to be extruding. In other instances the ulceration may extend round the whole anastomosis.

It is possible that carcinoma may follow anastomotic ulceration I have notes of two cases which are very suggestive, although they do not definitely prove it. In both patients, following a gastro-jejunostomy a malignant mass was found in a part of the transverse colon which is very rarely the seat of carcinoma. In both it involved the anastomosis, and it seems more than probable that it arose in the gastric mucous membrane from an anastomotic ulcer

Briefly stated secondary ulceration is due to persistence of an abnormal degree of gastric acidity after gastro-jejunostomy This may be the result of pyloric exclusion or faulty operation, the opening being too small or too near the pylorus or it may be due to failure to deal with the original infection to damage by clamps, or to the use of unabsorbable sutures.

Symptoms.—These may arise at any time from a few days to several years after the operation. In more than half the cases, symptoms appear within a year in 75 per cent. within two years, of opera

tion. In a few it is recorded that symptoms first appeared several years after operation. I believe however that invariably investigation will prove that symptoms, of which perhaps the patient took little notice, were present within a few months.

The cases fall into three groups—(i) those with acute symptoms of perforation or hæmorrhage (ii) those with symptoms suggesting recurrence of the original trouble (iii) those with perforation into the colon.

(i) Perforation into the general peritoneal cavity common after the anterior is rare after the posterior operation it occurred in one of the writer's cases. Before symptoms are produced following posterior gastro-jejunostomy the ulcer has usually perforated chronically and its floor is formed either of colon or of mesocolon. In the former case perforation into the colon may follow in the latter profuse hæmorrhage. This may be the first sign of the disease.

(ii) These are the more common cases. After a period of perfect comfort, usually lasting from six to nine months, pain recurs, often suggesting to the patient the pain experienced before his operation. It may come on late after food, be relieved by food, and wake him at night. Its site is important the patient complains of it as being low in the abdomen and generally on the left side. At first it comes in attacks, but later may be continuous. After the anterior operation, an abdominal tumour may develop as the result of subacute perforation and adhesions to the abdominal wall the swelling is usually in the region of the upper left rectus muscle and by involvement of abdominal wall a jejunal fistula may occur There is no characteristic difference between the symptoms caused by gastro-jejunal and by jejunal ulcer.

(iii) This is now a much more frequent occurrence, but it is still one of the rarest complications. The communication is ordinarily jejuno-colic, but if the ulcer which perforates is of the anastomotic type, both stomach and jejunum may communicate directly with the colon. Bolton and Trotter were able to collect 27 cases, and published 4 others, 3 of which were operated on by the latter The writer has operated on 5 cases.

The principal and sometimes the only *symptom* is diarrhœa. This has often been preceded by the typical pain of jejunal ulcer which has ceased on the appearance of the diarrhœa. Occasionally the onset is acute, with vomiting of fæculent material. In only 2 out of the writer's 5 cases was there vomiting

Diagnosis.—Secondary ulceration should always be suspected when painful symptoms follow gastro-jejunostomy Gastric acidity is usually high, and X ray examination after a bismuth meal often corroborates the diagnosis by revealing irregularity of the anastomosis.

Treatment.—This should be preventive. Before operation, all septic foci in the mouth and elsewhere should be attended to. The gastro-jejunostomy should be of the no-loop type and, if possible, posterior If from the presence of adhesions this is impossible, then the anterior no-loop operation should be done (p 423) The anastomotic opening should be large, and situated immediately below the cardiac orifice. It is the writer's experience that the *nearer the* pylorus the opening, the less the postoperative lowering of acidity This is confirmed by Panchet. The whole abdominal cavity should be *investigated*, and any *other disease there* present dealt with. Treatment must not cease with the performance of gastro-enterostomy (p. 380).

When perforation has occurred, laparotomy with immediate suture must be carried out. This is the life-saving measure but the causes leading to the production of the ulcer may still be acting, for in several cases after the successful suture of a perforation another has occurred at a later date. The condition of the stomach and the size of the anastomotic opening are to be investigated if the latter is too small or has closed, the defect must be remedied if possible. During recovery means should be taken to prevent hyperacidity and *if the operation is found to have been faulty rectification of* this should be discussed In the second group of causes, prolonged medical treatment should be tried. If this fails, operation should be performed, the anastomosis excised, and a fresh no-loop operation done or both limbs implanted into the stomach. It may sometimes be possible to restore the continuity of the intestinal canal with the addition of a plastic operation on the pylorus. A partial gastrectomy is sometimes necessary

In the third group the viscera should be separated, the opening in the colon closed and a fresh gastro-jejunostomy or a partial gastrectomy performed.

The operative treatment of jejunal ulcer is one of the most difficult in surgery and no set rules can be laid down

4. **Contracture and closure of the opening** is due to gastro-jejunal ulceration, the result of the use of unabsorbable suture material. It more often followed operation performed with the aid of Murphy's button, with its necessary ulceration of the margins of the opening If *catgut only is* used *for* the anastomosis a closure never occurs.

5. **Intestinal obstruction.**—After posterior operations internal hernia has occurred into the lesser sac (Moynihan, Hartmann, Ashurst) This is to be prevented by *suturing the edge of the opening in the* mesocolon to the stomach.

Strangulation has taken place beneath the loop formed in anterior gastro-jejunostomy more rarely in the posterior operation. The colon

has been obstructed in the former. Cases of retrograde intussusception of the jejunum into the stomach have been recorded by Warren, Lundberg, and Hamilton Drummond.

Diarrhœa occasionally occurs after gastro-jejunostomy. It has been noticed most often in cases of carcinoma. Its causation is unknown. As a rule it soon passes off but it has been fatal. In one case which proved fatal Kelling could discover no cause post mortem.

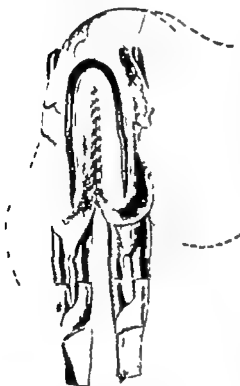


Fig. 399.—Finney's operation of gastro-duodenostomy.

GASTRO-DUODENOSTOMY

This operation is rarely employed, except as Finney's modification, which is explained by Fig. 399. It is useful in cases of fibrous stricture of the pylorus and certain cases of gastroptosis. Secondary ulceration may follow at the line of suture if non-absorbable material has been employed. The writer has operated upon two such cases.

JEJUNOSTOMY

This should be done by Mayo Robson's method. A loop of jejunum is taken as high as possible allowing sufficient length to reach the abdominal wall easily. The two arms of the loop are short-circuited by lateral anastomosis. An opening is made at the top of the loop, then a No. 12 catheter is inserted and passed for 3 in. into the distal limb of the loop, and the margin of the opening inverted by two purse-string sutures. The apex of the loop is fixed to the skin.

SELECTED BIBLIOGRAPHY

Bolton, Charles, *Ulcer of the Stomach.* 1913.
Brinton, *Lectures on the Diseases of the Stomach*, 2nd edit. London, 1864.
Deaver, J. B., and Ashurst, A. P. C., *Surgery of the Upper Abdomen*, 2nd edit., 1921.
Fenwick, W. Soltau, *Cancer and other Tumours of the Stomach* (1902); *Ulcer of the Stomach and Duodenum and its Consequences* (1900).
Habershon, S. H., *Diseases of the Stomach.* 1909.

Moynihan, B. G. A., *Duodenal Ulcer* 2nd edit. 1912.
Osler and McCrae, *Cancer of the Stomach*. 1900.
Paterson, Herbert J., *Gastric Surgery* 2nd edit.
Robson, A. W. M., and Moynihan, B. G. A., *Diseases of the Stomach and their Surgical Treatment*, 2nd edit., 1904.
Sherren, James, *Lectures on the Surgery of the Stomach and Duodenum*. 1921.

ANATOMY AND PHYSIOLOGY

Barclay, A. E., *Proc. Roy. Soc. Med.*, Feb., 1909; *Brit. Med. Journ.*, 1910 ii. 537
Bythell and Barclay, *X Ray Diagnosis and Treatment*. 1912.
Dobson, J. F., and Jamieson, J. K., *Lancet*, 1907 i. 1061.
Hurst, A. F., *Brit. Med. Journ.*, 1908, i. 130; 1911 i. 477; *Quarterly Journ. Med.*, July 1910; *Brit. Med. Journ.*, April 24, 1920 p. 559.
Reeves, T. B., *Surg., Gynecol. and Obst.*, April, 1920 p. 374.

CLINICAL EXAMINATION INVESTIGATION BY OPAQUE AND TEST MEALS, ETC.

Carman, R. D., *Roentgen Diagnosis of Diseases of the Alimentary Canal*, 2nd edit.
Head, H., *Brain*, 1893, xvi. 1; 1894, xvii. 339.
Head, Rivers, and Sherren, *Brain*, Nov., 1905.
Hurst, A. F., *The Sensibility of the Alimentary Canal*. 1911
Knox, R., *Radiography and Radio-therapeutics*, 3rd edit., vol. i.
Lennander, *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, Bd. x. Hefte 1 2; Bd. xv., *Heft 5; Bd. xvi, Heft 1; Deuts. Zeits. f. Chir.*, Nov., 1906.
Panton, P. N., and Tidy, H. L., *Quarterly Journ. Med.*, July 1911 vol. iv., No. 16.
Ryle, John A., *Lancet*, Sept. 4, 1920 p. 490
Sherren, James, *Clin. Journ.* June 28, 1905.
Willcox, W. H., *Med. Soc. Trans.*, xxxi. 229; *Lancet*, 1910 i. 1119.

MALFORMATIONS, ETC.

Barnard, H. L., *Contributions to Abdominal Surgery* edited by James Sherren, p. 144.
Clogg, H. S., *Lancet*, 1904, ii. 1770
Cole and Roberts, *Surg. Gynecol. and Obst.*, Oct., 1920 p. 376.
Keith, Arthur, *Brit. Med. Journ.*, 1910 i. 303.
Kellog, *Ann. of Surg.* May 1921, p. 578.
Kuliga, *Beitr. z. path. Anat.* 1903, xxxiii. 481.
Stavely, *Johns Hopkins Hosp. Bull.*, 1908, p. 252.
Wilkie, D. P. D., *Edin. Med. Journ.*, Sept., 1913; *Brit. Journ. Surg.*, Oct., 1921 p. 204.

INFANTILE STENOSIS

Burghard, F. F., *Trans. Clin. Soc.* xl. 122.
Cautley and Dent, *Med. Chir. Trans.*, 1903, lxxxvi. 471; *Brit. Med. Journ.* 1906 ii. 939
Downes, W. A., *Journ. Amer. Med. Assoc.*, July 24, 1920, p. 228.
Gray, Tyrell, and Pirie, *Lancet*, 1919 ii. 515.
Hutchison, Robert, *Brit. Med. Journ.*, 1910 ii. 1021.
Ramsay, H. A., *Brit. Journ. Surg.*, April, 1921, p. 408.
Still, G. F., *Lancet*, March 11 1905; *Common Disorders and Diseases of Childhood.*
Strauss, A. A., *Surgical Clinics of Chicago* Feb. 1920 p. 93.
Thomson, John, *Clinical Examination and Treatment of Sick Children* *Edin. Med. Journ.*, Jan., 1921, p. 10.

HOUR-GLASS STOMACH

Delamere [redacted] Dieulafé, *Bull. et Mém. de la Soc. Anat.*, Paris, 1906, viii. 467
Downes, W. A., *Ann. of Surg.* 1909 ii. 552, 646.
Hurst, A. F., and Rowlands, R. P. *Guy's Hosp. Repts.*, April, 1921 p. 166.

Moynihan, B. G. A., *Med. Chir. Trans.*, lxxxvii. 143; *Brit. Med. Journ.*, 1901 i. 414.
Veyrassat, *Rev. de Chir.*, Aug., Sept., Dec., 1908, xxxviii. 200, 403, 761.
Wölfler, *Beitr. z. kl. Chir.*, 1895, xiii. 221.

ACUTE DILATATION OF THE STOMACH

Borchgrevink, O. J., *Surg., Gynecol. and Obst.*, June, 1913, p. 662.
Box, C. R., and **Wallace**, Cuthbert, *Clin. Soc. Trans.*, 1898, xxxi. 241; *Lancet* 1901, ii. 1259; 1911, ii. 214.
Doolin, Wm., *Brit. Journ. Surg.*, July 1918, p. 1.3.
Lafler, Walter B., *Ann. of Surg.*, 1908, i. 390.
Nicholls, A. G., *Internat. Clin.*, 1903, iv. 80.
Schnitzler, *Wien. klin. Rundsch.*, 1895, No. 25.
Thomson, H. Campbell, *Acute Dilatation of the Stomach*, 1902.

INJURIES OF THE STOMACH AND DUODENUM

Berry, J., and **Giuseppi**, Paul L., *Proc. Roy. Soc. Med.*, Surgical Section, Oct. 13 1908, p. 41.
Elliott, T. R., and **Herbert**, Henry, *Brit. Med. Journ.*, April 8, 1916.
Forgue et Jeanbrau, *Rev. de Chir.*, 1903, xxviii. 285.
Moerwein, *Beitr. z. klin. Chir.*, 1907, liii. 496.
Wallace, Cuthbert, *War Surgery of the Abdomen*, 1918.

CHRONIC GASTRIC AND DUODENAL ULCER

Balfour, Donald C., *Ann. of Surg.*, Nov., 1910, p. 622; *Surg., Gynecol. and Obst.*, Oct., 1914, p. 528; June 1917, p. [illegible]
Dawson, Lord, *Med. Soc. Trans.*, 1902, xxvi. 55; *Brit. Med. Journ.*, May 9, 1908; *Lancet*, 1911, i. 1124.
Hale-White, W., *Lancet*, 1906, ii. 1180; *Med.-Chir. Trans.*, xc. 215; *Lancet*, 1910, i. 1819.
Mayo, C. H., *Ann. of Surg.*, March, 1921, p. 325; *Brit. Med. Journ.*, Oct. 23, 1919; July 24, 1920.
Mayo, W. J., *Ann. of Surg.*, 1908, i. 885; 1911, ii. 312.
Miles, Alexander, *Edin. Med. Journ.*, 1906, pp. 106, 222.
Miller, C. H., *Arch. Path. Inst. London Hospital*, 1906, i. 20.
Moynihan, B. G. A., *Ann. of Surg.*, 1908, i. 873; *Brit. Med. Journ.*, 1910, i. 241; *ibid.*, July 24, 1920; *Med.-Chir. Trans.*, 1906, lxxxiv. 471; *Proc. Roy. Soc. Med.*, Surgical Section, Dec. 14, 1909, p. 69; Jan. 11, 1910, p. 97 (discussion).
Paterson, H. J., *Trans. Roy. Soc. Med.*, Surgical Section, 1920, p. 141.
Rosenow, E. C., *Surg., Gynecol. and Obst.*, July 1921, p. 19.
Sherren, James, *Trans. Clin. Soc.*, 1907, xl. 156; *Med. Press*, April 7 and 14, 1909; *Lancet*, April 1, 1911; *ibid.* 1920, i. 691; *Trans. Roy. Soc. Med.*, Surgical Section, 1920, 1922.
Tylecote, *Lancet*, 1913, ii. 1613.
Wilkie, D. P. D., *Edin. Med. Journ.*, Sept., 1914.

CARCINOMA OF THE STOMACH

MacCarty, W. C., and **Broders**, A. C., *Arch. Int. Med.*, Feb., 1914, p. 1.
Mayo, C. H., *Ann. of Surg.*, Aug., 1919, p. 227.
Mayo, W. J., *Journ. of Amer. Med. Assoc.*, 1910, liv. 909; *Surg., Gynecol. and Obst.*, Dec., 1914, p. 683.
Moynihan, B. G. A., *Trans. Clin. Soc. Lond.*, 1906, xxxix. 84; *Brit. Med. Journ.*, 1906, i. 370; 1909, i. 830; 1920, ii. 100.
Paterson, H. J., *Brit. Med. Journ.*, 1910, ii. 933.
Pauchet, *Traité Chirurg. des Affect. de l'Estomac*, Paris, 1919, 6; *Journ. de Chir.*, xvi., No. 2, p. 129.
Sherren, James, *Clin. Journ.*, Oct. 19 and 20, 1910; *Brit. Med. Journ.*, June 24, 1911; *Lancet*, 1920, i. 691.
Wilson and MacCarty, *Amer. Journ. Med. Sci.*, Dec., 1909.
Wilson and MacDowell, *ibid.*, Dec., 1914, p. 790.

Carcinoma of the Duodenum

Coffey R. C., *Ann. of Surg* 1909 ii. 1238.
Desjardins, *Rev. de Chir* June 10 1907
Jefferson, Geoffrey *Brit. Journ. Surg* Oct., 1916, p. 209
Kausch, *Zentralbl. f Chir.*, 1909, p. 1351.
Rolleston, *Diseases of Intestine and Peritoneum* (Nothnagel, English translation) p. 440
Sauvé *Rev. de Chir.*, Feb. 10 1905.

Sarcoma of the Stomach

Douglas, John, *Ann of Surg.*, May 1920, p. 628.
Haggard, W D., *Surg., Gynaecol. and Obst.*, Nov., 1920, p. 505.
Lecène et Petit, *Revue de Gynec. et de Chir Abdom.* 1904 p 965.
Salaman, R. N., *Trans. Path. Soc. Lond.*, 1904 lv part iii. 324.
Sherren, James, *Brit. Med. Journ.*, 1911, ii. 593.

Tuberculosis, Syphilis, Plastic Linitis

Broders, A. C., *Surg., Gynaecol. and Obst.*, Nov., 1917 p. 490.
Eusterman, G. B., *Amer Journ. Med. Sci.*, Jan. 1917 p. 21.
Jonnesco et Grossman, *Rev de Chir* 1908, xxxvi. 18.
Leith, R. F., Allbutt's *System of Medicine*, 1907 iii. 437
Lyle, H. H. M., *Ann. of Surg.*, 1911 ii. 625
Smithies, F., *Journ. Amer Med. Assoc.*, Aug 4 1916 p. 572.
Thomson, Alexis, *Brit. Med. Journ.*, 1910 ii. 949
Thomson, Alexis, and Graham, *Ann. of Surg* July 1913, p. 10.

Gastro-Jejunostomy

Brenner *Wien. klin. Woch.*, 1892, v 275.
Hutchison, Robert, *Brit. Med. Journ.*, May 3, 1919
Lamson, quoted by Mayo, C. H., *Ann. of Surg.*, March 1921 p. 332.
Moynihan, G. B. A., *Brit. Med. Journ.*, 1919 July 12.
Paterson, Herbert J., *Lancet*, 1907 ii. 815.
Pauchet, *Bull. de l'Acad. de Méd.* Aug. 14, 1920, p. 507

Jejunal Ulcer

Balfour, C., and Trotter W., *Brit. Med. Journ.*, June 5, 1920, p. 757
Braun, *Verhandl. d. Deutsch. Gesell. f Chir* 1899, T ii, S. 24.
Carman, *The Roentgen Diagnosis of Diseases of the Alimentary Canal*, 2nd edit., p. 368.
Connell, *Surg., Gynaecol. and Obst.*, 1908, p. 120.
Delore, *Lyon Méd.*, May 10, 1920, p. 391
Judd, E. S., *Surg., Gynaecol. and Obst.*, 1921 p. 120.
Lion et Moreau, *Rev. de Chir.*, xxix. 5.
Paterson, H. J., *Ann. of Surg* 1909, ii. 367
Rubritius, H., *Beitr z. klin. Chir.*, 1910, lxvii. 222.
van Roojen, *Arch. f klin. Chir.*, 1910, xci. 380
Wright, Garnett, *Brit. Journ. Surg.*, Jan. 1919, p. 390.

THE INTESTINES

By ALEXANDER MILES M D F R.C.S Ed

For the purposes of this article, the intestines may be taken to include that portion of the alimentary canal which extends from the termination of the duodenum at the duodeno-jejunal junction to the lower end of the pelvic colon, where it becomes continuous with the rectum. Although the duodenum belongs anatomically to the small intestine, its surgical associations are with the stomach and are considered in the preceding article. The vermiform appendix and the rectum are also most conveniently described elsewhere (pp 549 and 670)

ANATOMY

The **small intestine**, arbitrarily divided into jejunum and ileum, is about 20 ft. in length, and with the exception of the first part of the jejunum and the terminal part of the ileum, which are fairly constant in their position, the numerous coils enjoy a wide range of mobility and show considerable variation in their disposition As a rule, however the jejunum, which includes the first 8 ft. of the canal, lies towards the upper and left part of the cavity below the level of the stomach, while the ileum, about 12 ft in length, lies in the lower and right regions. Although there is no definite point of transition between the two portions, in the living subject the jejunum can usually be distinguished from the ileum by its greater width, its thicker and more vascular walls, its brighter colour and the more prominent yellow lines formed by the lacteals. The valvulæ conniventes are larger and more closely approximated in the jejunum, while the Peyer's patches are larger and more numerous in the ileum.

The arcades formed by the mesenteric vessels become more numerous as we pass down the intestine, while the vessels entering into their formation become smaller (Monks).

The **mesentery** is a double fold of peritoneum which connects the small intestine to the posterior abdominal wall along a line 6 or 7 in in length, extending from the left side of the second lumbar

vertebra downwards to the right iliac fossa. Between its layers are conveyed the blood vessels—intestinal branches of the superior mesenteric artery and vein the lymphatics, which are connected with numerous (40–150) mesenteric glands and the nerves of the superior mesenteric plexus, derived from the solar plexus. Some fibres from the vagus ultimately reach the intestine. The bowel itself is enclosed in the free border of the mesentery which thus furnishes it with its serous covering

The ileo-cæcal junction.—The opening between the small and the large intestine—the ileo-cæcal orifice—is guarded by the ileo-cæcal valve composed of two crescentic segments enclosing a slit-like opening, which when the cæcum is distended, is closed and prevents regurgitation of its contents into the small intestine. In all likelihood, the circular fibres of the lowest part of the ileum form, as in some animals, a true muscular sphincter A short distance below the valve, the vermiform process opens into the cæcum.

The **large intestine,** or **colon,** extends from the cæcum, which occupies the right iliac fossa, to the beginning of the rectum in the pelvic cavity It is about 5½ feet in length its widest part is the cæcum, which, when distended, has a diameter of about 3 in. and from this it gradually narrows till, at the lower end of the pelvic colon it is only about 1½ in. in diameter

When the abdomen is opened, the normal colon can be distinguished from the small intestine by its sacculated appearance, by the presence of three longitudinal muscular bands running along its surface and by the appendices epiploicæ which project from its serous covering. When the bowel is greatly distended, and is covered with inflammatory exudate it may be difficult to distinguish large from small intestine.

While it may be said that normally the colon arches across the small intestine the coils of which lie within the concavity of its curve, those segments of the bowel that are completely enveloped by peritoneum or that have a mesentery are subject to great variations in their disposition. The cæcum, for example instead of lying in the right iliac fossa, may be found in the right lumbar region, even as high as the under aspect of the liver or it may hang down into the pelvic cavity The transverse colon, which normally passes across the abdomen in the upper part of the umbilical region, in a direction upwards and to the left, frequently dips downwards as a U or V-shaped loop, reaching sometimes to the pubes, and thus increasing the sharpness of the angles at the hepatic and splenic flexures. When distended with gas, it may rise in front of the stomach. The pelvic colon also varies considerably in length and position. It may form a short, horseshoe-shaped loop of not more than 6 or 8 in., or may be two or three times as long, and be thrown into several curves, assuming an S or Ω-shape, in which case it is not always easy during an operation to recognise the direction in which a particular part is running, especially if the bowel is distended. Being provided with a well-developed mesentery it enjoys a wide range of movement, and when distended it may reach any part of the abdominal cavity

The ascending colon, the hepatic (right) and the splenic (left) flexures,

and the descending and iliac portions are more constant in their position as they are not completely enveloped by peritoneum, and are to some extent fixed to the posterior abdominal wall by areolar tissue

Blood supply.—The cæcum and appendix are supplied by the ileo colic branch of the superior mesenteric artery the ascending colon by the right colic and the transverse by the middle colic branch of the same trunk.

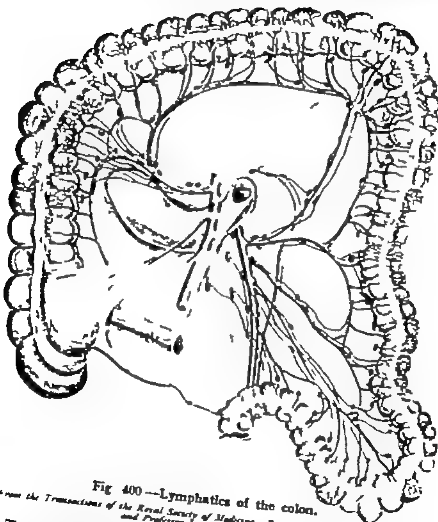


Fig 400.—Lymphatics of the colon.
(From the Transactions of the Royal Society of Medicine. By courtesy of M J F Dobson and Professor J Jamieson. Reduced.)

The descending colon receives its blood from the left colic and the iliac and pelvic colons from the sigmoid arteries, branches of the inferior mesenteric The veins correspond to the arteries.

Lymphatics.—The lymphatics, after leaving the bowel, pass in the mesocolon to different groups of glands lying along the course of the branches of the superior and inferior mesenteric arteries. Their arrangement has been studied by Jamieson and Dobson, and is shown in Fig. 400.

obstruction to the onward passage of intestinal contents, and another in which there is paralysis of the intestinal wall.

In the first type, which is exemplified by strangulated hernia and malignant stenosis, intestinal movements are present in an exaggerated degree. Cannon experimentally produced a similar condition by tying a string round the gut in the upper part of the jejunum, and on watching the progress of an opaque meal along the bowel he observed that the food passed out of the stomach normally and was carried along the duodenum. When it reached the obstruction, powerful peristaltic waves followed each other in quick succession and hurled the contents against the barrier As the intra intestinal pressure rose, some of the fluid was squirted back through the narrowed lumen of the contracted portion by peristalsis. In this way part of the contents might reach back to the pylorus, and so enter the stomach, without the occurrence of any antiperistaltic waves. In a second experiment, in which he stopped the progress of intestinal peristalsis by reversing one of the uppermost loops of the jejunum, antiperistaltic waves apparently occurred and carried the food back to the pylorus. Grützner administered enemata of saline solution in which were suspended starch grains, charcoal, lycopodium, and other substances, and he recovered these particles from the stomach and small intestine. Such a result can only be explained by the occurrence of antiperistalsis.

When the intestine is paralysed, as in general peritonitis, it is difficult to conceive that one movement—that of antiperistalsis—should remain when the other movements are lost. In these cases the "fæcal" vomiting is associated with distension of the bowel, the contents of which are decomposing and evolving gases that increase the pressure in the canal. This pressure may become so extreme that the bowel is kept from bursting only by the resistance of the abdominal wall. Hence, at any given point of the bowel, the contents will pass in the direction of least resistance. At the lower end of the ileum is the ileo-cæcal sphincter which, we know may be tightly contracted although no movements are occurring in the rest of the small intestine. If, as is probable, it is in the same condition in general peritonitis, then the accumulating gases and the copious secretion which they as irritants induce must gradually force their way upwards and finally reach the stomach, from which the gases are got rid of by frequent eructations and the liquids by vomiting.

The results following the administration of enemata in advanced general peritonitis favour the theory that the ileo-cæcal sphincter is strongly contracted. Once the colon has been cleared, the injected fluid is returned unaccompanied by any intestinal contents, although under normal conditions part of the enema reaches the small intestine and empties its lower coils.

In cases of strangulated hernia the same explanation of "fæcal" vomiting is possible, because often it does not begin till all pain has ceased and the distension of the intestine is extreme.

Movements of the Colon

Antiperistalsis is the most frequent movement in the cæcum, and in the ascending and proximal half of the transverse colon. As soon as food enters the large intestine, a powerful contraction of the colon carries it some distance from the ileo-cæcal valve; then antiperistaltic waves begin to pass rhythmically from the most advanced portion of the food, and travel backwards to the cæcum. These waves occur in "periods," during each of which they are small to begin with, gradually reach a maximum, and then die away The period lasts for two to eight minutes in the cat, and periods recur at

intervals of ten to thirty minutes, the bowel remaining at rest between them. In this way the food is thoroughly mixed and presented for absorption. As food accumulates, it reaches the neighbourhood of the splenic flexure where the first "constriction ring" is usually seen. When the intra-intestinal pressure rises, as the food cannot force the ileo-cæcal sphincter, some of it may escape onwards through the ring. Though this explanation is the one commonly accepted, it is possible that the passage of the most advanced contents *into the descending colon is brought about by waves of contractions behind them.* Otherwise the evacuation of the half-empty colon is difficult to explain. That contractions do pass from the cæcum along the whole length of the large intestine is proved by Hurst's observations on the act of defæcation in man.

In complete obstruction of the colon at some distance from its commencement, the antiperistaltic waves continue to drive the food backwards, and none of it can move upwards. As the pressure rises, the cæcum becomes dilated, and all the subjective symptoms may be referred to the right iliac fossa. In cancer of the pelvic colon, this sometimes leads to confusion in diagnosis.

Constriction rings.—With the increasing accumulation of food in the ascending and transverse colon, constrictions appear and separate the contents into a series of spherical masses. These increase in number and gradually assume a position farther from the cæcum, so that they lie for the most part below the splenic flexure. In man, the first is about the middle of the transverse colon (Hurst). With the slow movement of the constriction *rings, the contents are gradually pushed onwards along the descending and* the pelvic colon. This movement corresponds with peristalsis in the small intestine, and each ring is associated with an area of dilatation in the gut below it.

Oscillating contractions of the walls of the sacculi have been observed in the excised colon (Elliott and Barclay-Smith). In all probability they assist in the churning of the contents.

In defæcation a strong contraction occurs to empty the distal colon. According to Hurst, who has actually observed the process in man by means of the fluorescent screen, the contraction starts at the cæcum, and proceeds along the whole length of the colon, driving the contents farther down. It is followed by similar waves, each of which empties the pelvic colon of part of its contents.

When *nutrient enemata* are administered, the contents lie at first in the *descending and pelvic colon,* and are then carried by antiperistaltic waves towards the cæcum. Hence the function of antiperistalsis is inherent in the colon throughout its whole length, although under normal conditions it is not called into action beyond the splenic flexure. The repeated passing of the waves mixes the contents of the enema with any digestive juices that may be present, and promotes absorption of the nutriment at least as far down as the splenic flexure; beyond this there is little evidence of the absorption of anything except water. *From Cannon's experiments on animals it seems* likely that, if a bulky enema is administered, part of it reaches the lower ileum.

INNERVATION OF THE INTESTINE

The intestine can carry on its functions to a great extent independently of the central nervous system. In its walls lie two nerve-plexuses with ganglionic cells—Meissner's plexus in the submucosa, and *Auerbach's* plexus between the circular and longitudinal layers of muscle. Meissner's

plexus is distributed to the mucous membrane, glands, and villi, and is concerned with the secretory activities. Auerbach's plexus controls the movements of segmentation and peristalsis in the small intestine, and of antiperistalsis and the tonic constrictions in the colon. Hence these movements can be *investigated in the excised gut, and they can be induced or inhibited* by various mechanical and chemical stimuli. Thus, pinching of the gut, or the introduction of butyric or some other organic acid, stimulates peristalsis, and oxygen gas *inhibits it*. The best stimulus is a bolus introduced into the lumen, apparently because it produces a local distension of the bowel.

At the same time, the intestine is linked to, and its functions are under the influence of, the central nervous system. It is through these connexions that the emotions influence the processes of digestion, and may produce derangements of the alimentary functions.

The small intestine is innervated by the vagi and the splanchnics. The latter are also distributed to the large intestine, and the fibres corresponding to those of the vagi are supplied by *sacral nerve-roots through the pelvic* visceral nerves. The extrinsic nerve supply gradually increases in activity and the local mechanism decreases, from the ileo-cæcal valve to the anus. Thus, the strong contraction of the colon that produces *defæcation* is due to stimulation of the fibres of the sacral nerve-roots.

The relationship between the three systems—local, sympathetic, and cerebro-spinal—is extremely complex, and is still imperfectly understood, but several facts have been experimentally established. Segmentation and peristalsis in the small intestine, and antiperistalsis and peristalsis in the colon, which are the result of a local reflex action effected through Auerbach's plexus, are inhibited by the splanchnic nerves, irritation of which, as in many acute abdominal inflammations, arrests the movements and produces constipation.

The vagi contain inhibitory and augmentor fibres for the small intestine. *If they are cut and their distal ends stimulated, there may be temporary* diminution or cessation of movements—that is, inhibition but if the stimulation is repeated five or six times, inhibition is followed by augmentation of movements. *After the vagi were cut*, Cannon observed a definite weakness in peristaltic contractions, with, however marked improvement in a few days; when both the vagi and the splanchnics were cut, the peristaltic contractions were practically normal in appearance, but the transit of food was slow

The *ileo-cæcal valve* is also under nervous control. The existence of a definite sphincter muscle at the lower end of the ileum has been experimentally proved (Elliott and Keith).[1] By impulses carried by the splanchnic nerves it is kept in a condition of moderate tonic contraction, sufficient to prevent regurgitation of material from the cæcum. When these nerves are cut, free mingling of the contents *of the small and large intestine takes place.* It would also seem to be relaxed when large nutrient enemata are given, a special reflex perhaps called into play by the emptiness of the ileum. Stimulation of the splanchnic nerves, which stops intestinal movement, strongly contracts the ileo-cæcal valve. During the peristaltic movements of the lower *ileum, the sphincter relaxes in front of* each contraction and allows food to pass to the cæcum; when antiperistalsis begins in the colon, it closes and prevents regurgitation.

These considerations *are of practical importance; for* example, the early administration of fluids by the rectum, after an operation for removal of the

[1] In man, however *digital examination during operations* leaves some doubt whether the sphincter is really a strong muscle

appendix, may so increase the pressure within the cæcum as to burst the sutures with which the stump is invaginated, and this may lead to the formation of a fæcal fistula.

Sensibility of the Intestine and Peritoneum

In contrast to the parietal peritoneum, the normal intestine and the visceral peritoneum are insensitive to touch and pain. A loop of bowel may be pinched, incised, or even divided with the cautery without the patient feeling it, and advantage is often taken of this fact in carrying out the second stage of the operation of colostomy.

Excessive peristalsis, such as is set up by interference with the blood supply of the intestine or the presence of an irritant in its lumen, and distension of the bowel, give rise to painful sensations, which are probably associated with traction exerted on the parietal peritoneum through the mesenteries.

Referred pain.—The existence of referred pain has long been recognized, and there is an increasing number of clinicians, of whom James Mackenzie was the pioneer, who believe that the viscera are not supplied with any nerve-fibres that are capable, under either normal or abnormal conditions, of giving rise to sensations of pain. The evidence on this point is still conflicting and incomplete, but there is much in favour of the view that the pain of visceral lesions is not localized in the affected viscus, but is referred to an area on the surface of the abdomen determined by the segmental distribution of the sympathetic and sensori-motor nerves supplying it. The reflex arc by which such pain is referred is made up of the afferent sympathetic fibres of the autonomic system which reach the thoracico-lumbar segments of the cord, and the efferent sensori-motor fibres passing out from the same segment to the various structures in the abdominal wall—skin, areolar tissue, parietal peritoneum, and muscles. When a lesion of the intestine exists, the sympathetic fibres supplying the diseased area are irritated and convey abnormal impulses to their spinal cells, which are thus stimulated to a condition of hypersensitiveness. These cells in turn irritate neighbouring sensori-motor cells in the cornu, which send impulses along their axis-cylinders to their peripheral distribution, and these impulses of pain are interpreted by the brain as if they had originated at the periphery (Fig. 401).

The sensitive structures to which such stimuli may be referred are—(1) the skin and subcutaneous tissue, (2) the parietal peritoneum, (3) the muscles of the parietes, and the extraperitoneal areolar tissue, which is highly supplied with nerves; hence, referred pain may be manifested in any of these situations.

In addition to the subjective pain, there is *hyperalgesia* of the skin, muscle, and areolar tissue within the area supplied by the segments of the cord implicated, as may be elicited by pinching, stroking, or pressing the part. Pain is sometimes referred, through the sensori-motor nerves, to areas remote from the diseased viscus; for example, the pain in the deltoid region in disease of the biliary passages.

Muscular contraction and rigidity.—Motor cells in the cord are also irritated by abnormal impulses conveyed by the splanchnic fibres (*Fig. 401*), and this irritation manifests itself by causing "muscular rigidity" or by disturbing the "abdominal reflex."

Muscular rigidity is the reflex which is best recognized, and is a symptom of great diagnostic value. According to the extent of the lesion and the number of spinal segments involved, the rigidity may extend widely and

cause "boarding" of the whole anterior abdominal wall, or it may be localized to a small area. Unlike the muscles of the limbs, in which if part is stimulated the whole contracts, the muscles of the abdominal wall are capable of contracting in segments; hence, in limited intestinal lesions, a correspondingly small area of rigidity is present. The best examples of this are the rigid contraction of the upper portion of one or other rectus in cases of gastric or duodenal ulcer and the "boarding" of the muscles of the right iliac fossa in localized appendicitis. The contraction may be so well defined as to

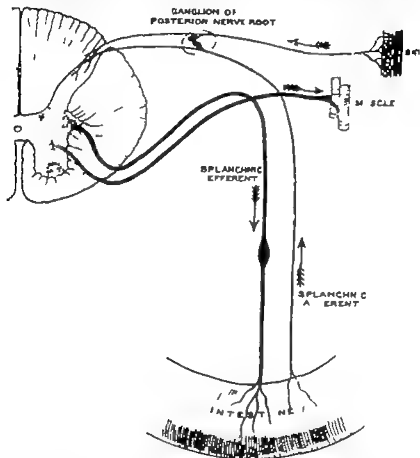


Fig 401 —Diagram of the course of reflex pain (see text, p. 445)

simulate a definite tumour In perforative conditions of the intestine, the rigidity involves the whole abdominal wall, as a result of the numerous reflexes set up by the widespread peritoneal irritation.

Clinically this rigidity may be detected by noting that the respiratory movements of the abdominal wall are restricted or absent in the contracted area; and on palpation this region is firm and "boarded."

The reflex muscular contraction cannot be voluntarily inhibited, and the rigid segment is the last to relax during the induction of anæsthesia. In chronic conditions in which the rigidity is of long standing, and in exception

ally acute inflammatory affections, the contraction may not be overcome even when the anæsthetic is pushed to the utmost limit of safety the fixation of the abdominal wall adding greatly to the difficulties of the operation.

In children who resist handling, it is more reliable to test the *abdominal reflex*. Any part of the muscle which is rigid does not twitch when the associated area of skin is stroked, as it is already in a state of contraction.

Reflexes between different parts of the alimentary canal.—Many of the clinical symptoms of disease in the intestine are to be explained by reflex influences exerted by one part of the tract on another or by one viscus on another For example, vomiting of stomach contents is a symptom common to many lesions of the abdomen, apart from those of the stomach, e.g. the onset of appendicitis, biliary colic, etc. Again, hyperchlorhydria may be induced by pathological changes in the vermiform appendix, which probably accounts for the condition spoken of as "appendicular dyspepsia."

Handling of one part of the intestine may inhibit the peristalsis in other parts, and lead to more or less complete stasis of intestinal contents. A striking example is the complete inhibition of gastric and intestinal movements which immediately follows a perforation or a bullet-wound of the stomach or intestine—a protective reflex which tends to prevent the escape of the bowel contents or their spread throughout the peritoneal cavity

Cannon has shown in the cat that resection of a portion of the jejunum, with end-to-end suture, was followed by closure of the pyloric sphincter which persisted for six hours—a period sufficiently long to admit of a protective plastic exudate forming at the seat of the anastomosis. When the resection was made low down in the ileum, the closure of the pylorus did not last so long, but the progress of the contents along the canal was retarded, a bismuth meal taking about seven hours to reach the seat of the anastomosis.

Excretory Function of the Intestine

The indigestible and unabsorbed residuum of the food, together with various digestive juices and masses of bacteria, is eliminated as fæces. The fæces normally contain connective-tissue fibres a small amount of muscle, traces of fat, fatty acids and soaps, remnants of starch, and inorganic crystals.

In the colon the bile pigments, bilirubin and biliverdin, are transformed by bacteria into stercobilin, which is partly reabsorbed and excreted by the kidney as urobilin. The characteristic odour of the fæces is due to skatol and indol, products of bacterial decomposition. Certain *ptomaines* are also produced in the lower bowel, and if absorbed give rise to toxic effects. In purgation, however the fæces may contain bile pigments.

With ordinary diet the reaction of the stools is almost neutral. If putrefaction of proteins is increased, as in intestinal tuberculosis and dysentery it becomes alkaline, and increased fermentation of carbohydrates produces acid stools.

The consistence of the fæces varies with the amounts of water fat, mucus, and indigestible residue that they contain. Scybala are composed of food taken some days previously and are formed in the sacculi of the colon.

The chief abnormal constituents of the fæces are mucus, blood, and pus. *Mucus* in more than a trace is present only in pathological conditions. If coloured yellow by bilirubin, it comes from the small intestine; if white it comes from the colon or rectum (Harley and Goodbody). In membranous colitis, greyish shreds or casts are passed at intervals. These may or may not contain many epithelial cells. According to Leathes, the casts are composed

of chitin derived from carbohydrates. Fibrin is also sometimes present in the shreds.

Blood in the fæces may occur in streaks or clots visible to the naked eye In intestinal ulceration the clots are frequently adherent to mucus. If tarry or like coffee-grounds, the blood comes from the small intestine or upper colon no red corpuscles are recognizable microscopically and the blood pigment is transformed to hæmatin. If from the pelvic colon, the blood is not so intimately mixed with the fæces. For traces of blood, the benzidin test is the most delicate. Fresh, unchanged blood usually comes from a lesion in the rectum, such as piles, ulcer or cancer

Pus is demonstrated microscopically The cells are less or more disintegrated according as the disease is in the pelvic colon or higher up. In malignant disease, pus and blood occur after ulceration of the growth.

Bacterial Decomposition

In the contents of the alimentary canal, great masses of bacteria are present, and it is commonly found that pathogenetic organisms, such as the pneumococcus and the streptococcus, show a greatly decreased virulence. It is often difficult to cultivate the organisms found in the intestinal canal, though bacteria which have escaped into the peritoneal cavity through the injured intestine are readily grown on artificial media.

The bacterial masses are first met with at the lower end of the ileum, though micro-organisms are present in smaller numbers higher up. They are abundant in the colon—so abundant that on an ordinary diet they constitute 33 per cent. of the dried fæces (Strasburger). According to Schütz, the difficulty of cultivation is due to the influence of a vibrio which rapidly devitalizes the bacteria. There is no doubt that the healthy intestinal wall also plays an important part in destroying abnormal bacteria and regulating bacterial growth. In health the bacterial flora is remarkably constant, and abnormal varieties are soon destroyed. The normal bacteria may be decreased by diet, but experimental observation has shown that they are little influenced by the so-called intestinal antiseptics.

Varieties of bacteria.—The majority belong to the *Bacillus coli* group. In some conditions these may reach the blood-stream, and they appear to produce mental unrest. They are excreted in large numbers by the kidneys, and their presence in the bladder sometimes produces cystitis. Other organisms are the *Bacillus lactis aerogenes* and the *Bacillus putrificus*, an anaerobe. The most important pathogenetic organisms are those of typhoid, dysentery and cholera, but streptococci and staphylococci, the bacillus of anthrax, and the *Bacillus pyocyaneus* may also be found. Tubercle bacilli can frequently be demonstrated, even when intestinal tuberculosis is *not* present and no bacilli are to be found in the sputum, but great care must be taken to distinguish them from the smegma bacillus which abounds at the anal orifice.

METHODS OF EXAMINATION

In the examination of the abdomen, the usual clinical methods are systematically employed. The patient should be flat on the back with the shoulders slightly raised on a pillow and the knees flexed so that the soles of the feet are flat on the bed. He should be instructed to breathe through the open mouth.

By **inspection** the presence of localized or general distension

may be recognised especially in spare subjects with thin abdominal walls. If the distension is extreme the skin appears smooth shining and stretched, and when it is due to ascites the umbilicus may project beyond the surface.

The movements of the abdominal walls in natural respiration and while the patient takes a series of full breaths, should be noted This is better appreciated by bringing the eye to the level of the abdomen and looking across it than by looking down upon it. Peristaltic movements can sometimes be seen through the parietes, and in cases of intestinal obstruction various patterns formed by the dilated coils of gut may be recognised. Movement of an intra peritoneal tumour can sometimes be observed. The presence of dilated veins in the abdominal wall is suggestive of some obstruction to the portal circulation or of pressure on the vena cava.

Palpation.—The student should acquire the habit of examining all the external hernial orifices as the first step in the palpation of the abdomen This having been done, the abdomen must be examined systematically the flat of the hand (not the finger-tips) being lightly placed on the skin and the examination should be so arranged that any manipulation likely to cause pain is reserved to the last After observing the respiratory movement in each segment of the abdominal wall the muscular rigidity is tested any localised area of "boarding" being specially noted

The condition of the wall having been thus determined, the hand is again passed over the abdomen to investigate the contents, each individual viscus and segment of the bowel being in turn felt for At first only a moderate degree of pressure should be exercised later if this is tolerated, deeper pressure can be made. In this way local or general distension of the bowel enlargement of a viscus, such as the gall bladder the spleen, or the pancreas, or the presence of a tumour may be recognised If a localised swelling is detected, its size, shape, consistence, and mobility should be determined, and an attempt made to ascertain whether it moves with respiration. The presence of tenderness (hyperalgesia) is then tested by pressing, pinching, and stroking, the extent of it accurately mapped out, and correlated with the segmental distribution of the nerve supply of the area involved. In estimating the degree of tenderness, more reliable information is obtained by watching the facial expression of the patient than from his verbal statements. A swelling in the line of the bowel should be firmly pressed upon with the finger tips to see if it is indented or "pitted" by the pressure—an indication that it is a fæcal mass.

In testing for fluctuation when ascites is suspected, an assistant should press with the ulnar side of his hand in the line of the linea alba to cut off vibrations of the parietes.

d

The lateral aspects of the abdomen should be examined with one hand placed behind in the loin and the other over the abdomen in front.

It is sometimes useful to examine the patient lying on the side or in the knee-elbow position

Percussion.—The note elicited by percussion over the hollow viscera is tympanitic the pitch varying with the quantity of gas present and its tension. The character of the note is influenced by the presence of fluid or fæces in the viscus. Under pathological conditions, it is not always easy to identify one part of the intestinal tract from another by percussion alone, but the employment of combined *percussion and auscultation* is sometimes helpful. The stethoscope is placed over the viscus under examination, and by percussing close to it the characteristic note of that viscus is recognized. Percussion is then made well beyond the limits of the viscus, and a different note is elicited If the percussion is now continued towards the stethoscope, the original note is again recognised when the limit of the viscus is reached. Variation in pitch of the note over different viscera may be detected by scratching the surface instead of percussing

When a moderate amount of free fluid is present in the peritoneal cavity as in ascites, the most dependent parts yield a dull note on percussion while the higher parts are tympanitic, as the intestine is floated up by the fluid. By changing the attitude of the patient, the dull and tympanitic areas are found to alter When the ascites is extreme, this test is less convincing

If the intestine is paralysed and full of fluid, a dull note may be elicited in the flanks, and, on succussion, splashing may be detected.

In every case the suprapubic region should be percussed to define the upper limit of the bladder and if it is found to be distended it should be emptied, by the catheter if necessary before the examination is completed.

Auscultation does not yield much information in abdominal conditions. In obstruction of the bowel, bubbling or gurgling sounds — stenosis noises —may be heard in relaxed and dilated bowel, splashing sounds may be elicited on succussion.

A digital examination of the rectum and vagina should be made in every case in which symptoms are referable to the intestine. Distension of the lower bowel with air or water is of doubtful value as a diagnostic measure, and is not devoid of risk.

The **Röntgen rays** are of value in determining the presence and position of foreign bodies in the intestine. After administration of an *opaque meal*—say bread and milk with which 2 oz. of subcarbonate (*not* subnitrate) of bismuth have been thoroughly mixed—the passage of the food along the intestinal canal can be traced by periodic observa

tions made through the fluorescent screen, or by taking a series of X ray photographs. Barium sulphate gives an even better radiographic picture than the bismuth salts. For the investigation of conditions in the colon, an emulsion of bismuth or barium in olive oil may be introduced directly into the bowel The results obtained by these measures when employed for the localisation of an obstruction in the bowel, require to be carefully interpreted, and they should not be allowed to outweigh those obtained by ordinary clinical methods.[1]

The **sigmoidoscope** is of value in investigating the condition of the lower bowel as far as the pelvic colon. The long tubular speculum, which carries a metal filament lamp to illuminate the bowel and is provided with a bellows by which air can be pumped in to distend the gut is passed with the patient in the knee-elbow position or in the left lateral or Sims position. In the introduction of the instrument care must be taken by altering its axis to round the curves without pressing on the wall of the gut.

MALFORMATIONS

Development.—In the early embryo the *primitive alimentary canal* is represented by an incomplete tubular cavity lying beneath the notochord and continuous with the yolk sac. As the embryo becomes folded in its growth this tube is differentiated into the *fore gut* from which are developed the pharynx, œsophagus, stomach, and duodenum as far down as the opening of the common bile-duct, as well as the organs formed as outgrowths from these the *hind-gut*, from which the rectum and a variable portion of the descending colon are developed and the *mid-gut*, which gives origin to the remainder of the intestinal canal. At first the mid-gut is continuous with the cavity of the yolk sac, but in time the communication becomes narrowed and constitutes the *vitelline duct* a remnant of which sometimes persists in the form of a Meckel's diverticulum.

As development proceeds, the primitive canal becomes greatly elongated, and the mid-gut is differentiated into the large and small intestines, the junction being indicated by an outgrowth which eventually forms the cæcum.

Concurrently with the elongation of the tube and the development of its mesentery which carries the superior mesenteric artery there is a rotation of the mid-gut which brings the large intestine across the duodenum, and the cæcum to the right side just below the liver From this position it gradually descends to the right iliac fossa. The small intestine goes on increasing in length, and is thrown into the complicated series of coils characteristic of the adult bowel.

[1] *See also* Vol. I., p. 692.

CONGENITAL CONSTRICTIONS AND OCCLUSIONS

The *small intestine* may be narrowed or occluded in a variety of ways. At the junction of the fore- and mid-guts, for example, the canal may be interrupted by a septum, or by an annular constriction, probably due to faulty development of the embryonic buds in which the liver and pancreas arise (Bland-Sutton). A complete segment of the bowel—jejunum or terminal portion of ileum—may be absent, together with a U-shaped portion of the mesentery; sometimes there are multiple defects. Among the other congenital lesions of the jejunum and ileum that have been met with are septa, localized strictures, and adhesions from fœtal peritonitis. The segment above the obstruction is dilated and elongated; that below is contracted.

Congenital defects in the *colon* are usually met with at the various flexures, where portions may be absent or septa may occlude the lumen.

DIVERTICULA

Congenital diverticula are occasionally met with in the region of the *duodenum*, and in a certain proportion of cases masses of pancreatic tissue are found at the fundus of the pouch.

In the *small intestine* acquired diverticula are not common. They are usually multiple, varying in size from a pea to a hen's egg, and are found on the mesenteric edge of the bowel, particularly towards the lower end of the ileum. They consist of pouches of mucous membrane protruded through the muscular coat along the line of the small vessels that enter and leave the submucous tissue, and they push themselves between the layers of the mesentery. These diverticula are probably due to increased intra-intestinal pressure and irregular contraction of the bowel. A case has been recorded by Alexis Thomson in which a localized focus of tuberculosis weakened the wall and admitted of the formation of a diverticulum; and another in which an accessory pancreas was present at the apex of the diverticulum. (Plate 93.)

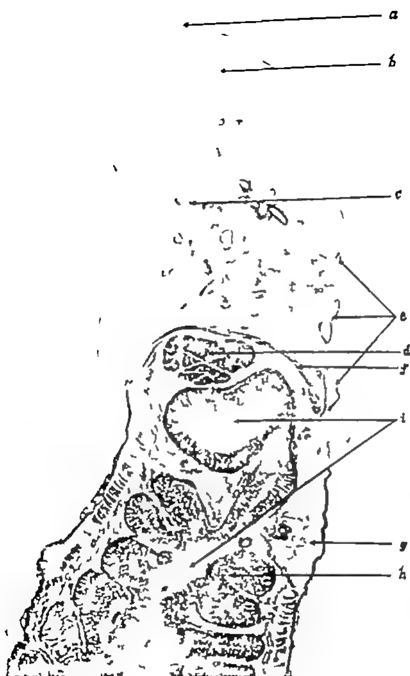
In the small intestine diverticula almost never give rise to symptoms or to secondary changes of an inflammatory nature.

Similar pressure diverticula are by no means uncommon in the *colon*, particularly in the pelvic colon and lower part of the descending colon. They are described on p. 522.

In some cases the formation of an abscess has resulted in the production of fistulous communications with the bladder.

Meckel's Diverticulum

Meckel's diverticulum is a congenital abnormality of the small intestine due to persistence of the intra-abdominal part of the vitelline duct, which, under normal conditions, should be obliterated during



Complete longitudinal section of diverticulum with accessory pancreas. × 5.

a, Extreme apex of diverticulum; *b* fat; larger portion of accessory pancreas embedded in extraperitoneal fat; *d*, smaller portion of accessory pancreas; blood-vessels; *f*, longitudinal muscle-fibres of coat of bowel; *g* circular muscle fibres; *h*, mucosa with villi and solitary glands; *l* lumen of diverticulum.

(*By courtesy of Professor Alexis Thomson. Edin. Med. Journ., vol. xxiii. New Series.*)

PLATE 93.

the sixth or seventh week of fœtal life It usually springs from the convex free border of the ileum somewhere within 3 ft. of its termination at the ileo-cæcal valve

Variation.—*As the process of obliteration may be arrested* at any stage this deformity manifests itself in many varieties. It has been estimated that a Meckel's diverticulum is present in 2 per cent. of human subjects, but in the vast majority of cases it is simply represented by a small thimble-like pouch which causes no trouble and gives rise to no inconvenience

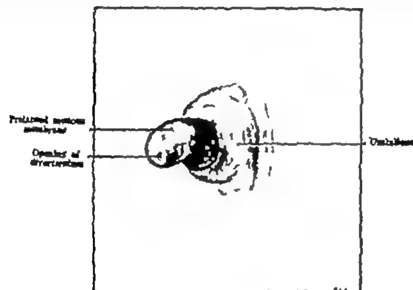


Fig 402 —Patent Meckel's diverticulum in a child æt. 1 year
(Author's case)

It may persist as a patent canal opening at the umbilicus at one end and into the ileum at the other constituting one form of umbilical fistula. The mucous membrane is sometimes prolapsed, forming a reddish, conical projection at the umbilicus (*Fig 402*) from which exudes a quantity of clear mucus, occasionally mixed with fæcal matter Sometimes it forms a sinus, opening at the umbilicus but ending blindly a short distance inside the abdominal cavity The most common form is a short tubular or saccular pouch of variable length (Fig. 403) with a well-formed mesentery which passes in front of the ileum and has an artery running in its free border or the mesentery may be merely *represented by a fibrous cord passing* from the mesentery of the ileum to the tip of the diverticulum. In other cases it is narrowed down to a long, vermiform or even filiform, process, which sometimes ends in a bulbous enlargement. (Fig 404)

On the other hand it may become pear-shaped or even spherical and undergo considerable hypertrophic thickening, and, if it becomes occluded at each end it forms a cystic tumour filled with mucus (Fig 405)

The structure of the pervious portion of the diverticulum is similar to that of the lower ileum. Masses of pancreatic tissue have been found embedded in the wall of the diverticulum, a condition which is probably to be explained by the fact that until the third week of development the mouth of the yolk sac extends up to the second part of the duodenum where the pancreas has its origin.



Fig 403.—Tubular form of Meckel's diverticulum.
(Anatomical Museum University of Edinburgh)

The vascular cord of the diverticulum may be represented by an impervious fibrous band—*the terminal ligament*—which is attached to the anterior abdominal wall at, or some distance below the umbilicus (Fig 404). The end of a free diverticulum or the terminal ligament may form new attachments to the mesentery of the ileum, to an adjacent coil of bowel or to some other viscus, and constitute an arcade or ring through which a loop of bowel may pass and become strangulated (Fig 406).

Complications.—1 Inflammation of a Meckel's diverticulum is attended *with symptoms closely resembling* those of appendicitis, a condition for which it is usually mistaken before the abdomen is opened.

2. In a considerable proportion of cases the ileum is narrowed at, or more frequently just above, the level at which the diverticulum

arises. This narrowing may be due to defective development of the segment implicated, or to cicatricial contraction following ulceration of the gut at the opening of the pouch, or it may result from traction exerted on the gut by the diverticulum or its mesentery

3. **Intussusception** is sometimes originated by a Meckel's diverticulum becoming inverted and projecting into the lumen of the ileum, where it forms the apex of the intussusceptum

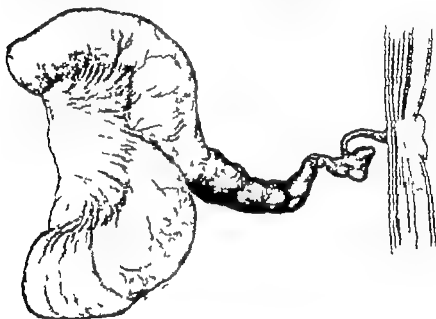


Fig 401 —Meckel's diverticulum attached to abdominal wall. (*Author's case*)

4. **Volvulus** has been produced by the weight of a distended Meckel's diverticulum rotating the bowel on its mesenteric axis or the diverticulum may itself be twisted on its long axis. The combination of volvulus and kinking is not uncommon

5 By far the most common complication is **strangulation of the bowel** by the diverticulum acting as a band. When the diverticulum remains attached to the umbilicus and stretches across the abdomen (Fig 401) a coil of bowel may be kinked over it hanging like a towel over a rope. More frequently the free end, by forming new attachments has made a ring through which a loop of bowel slips (Fig 400) When the apex remains free, and especially if it is long and ends in a rounded knob a loop of bowel may be snared or noosed by it and the knots thus formed may be most complicated.

The condition is most usually met with in young adult males with no history of previous injury or peritonitis such as would give



Fig 403.—Meckel's diverticulum forming a globular swelling. Surface. Section. (By courtesy of Mr J H Strachan, Ed Med Journ, [illegible])

rise to the formation of a fibrous band. The obstructive symptoms are not always acute at the onset, as the diverticulum does not grasp the bowel tightly but as it becomes œdematous and the constricted bowel distends they become more acute. Gangrene of the diverticulum soon supervenes or perforation occurs, and peritonitis sets in early. There are no symptoms by which strangulation of the bowel by a Meckel's diverticulum can be distinguished from obstruction due to other forms of band.

6. A Meckel's diverticulum, either alone or together with the portion of ileum from which it springs, may form one of the contents of an inguinal hernia, less frequently of a femoral hernia (Littré's hernia). Strangulation is a frequent complication of such hernias, but when the diverticulum alone is in the sac the symptoms are less acute than in strangulation of the ileum. Taxis is particularly dangerous, as the diverticulum is liable to rupture at

its base and owing to the poor blood-supply, gangrene and perforation of the diverticulum rapidly occur

The **clinical features** of these various complications differ but slightly from those of the same conditions arising from other causes, and the **treatment** is carried out on the same lines.

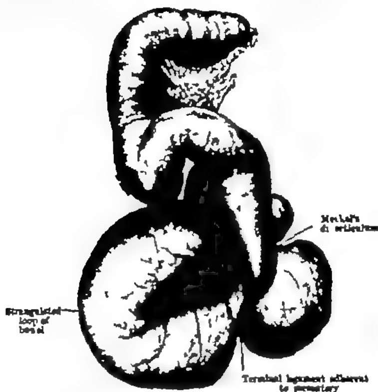


Fig 406.—Meckel's diverticulum causing obstruction of the bowel by snaring a loop of small intestine

(Anatomical Museum University of Edinburgh.)

HIRSCHSPRUNG'S DISEASE, OR CONGENITAL ENLARGEMENT OF THE COLON AND RECTUM (*Fig* 407)

The condition known as Hirschsprung's disease is usually met with in young children and is characterized clinically by obstinate constipation dating from birth, and extreme distension and enlargement of the abdomen The colon, in whole or in part and the rectum, are greatly dilated and hypertrophied, without there being any organic obstruction distal to the dilated portion.

Morbid anatomy.—From a study of the recorded cases, it would appear that the anal canal is usually normal the dilatation

beginning in the lower part of the rectum and affecting the bowel above it for a variable length, but usually including the pelvic colon

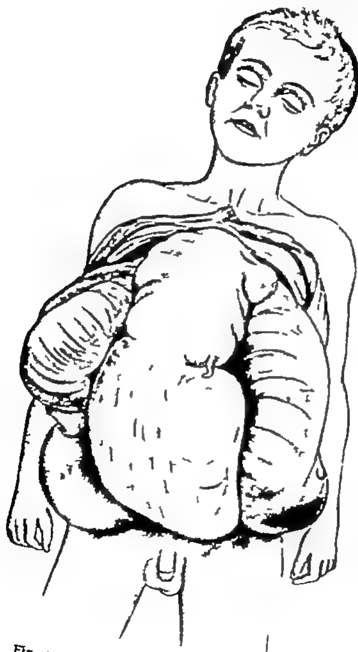


Fig [illegible] —Case of Hirschsprung's disease.

so that it forms an enormous loop, sometimes as thick as a man's thigh, and extending up to the costal margin. In most cases the dilatation affects the rectum and pelvic colon alone, but in some it extends to the iliac and descending portions of the colon. Less frequently the transverse colon is also enlarged, and still less frequently the ascending colon and cæcum. The small intestine invariably appears normal in size and structure

The wall of the affected portion is greatly thickened, chiefly from enormous hypertrophy of the circular muscular coat. In cases of long standing there is considerable fibrous hyperplasia of the bowel wall—an evidence of "chronic interstitial colitis."

When scybalous masses are retained in the dilated bowel numerous irregular ulcers of the mucosa, extending down to the circular muscular coat, are present. Perforation of such an ulcer has proved fatal The dilated bowel contains great quantities of gas, a variable but usually small amount of semi-solid fæcal matter and occasionally masses of hardened fæces.

On *microscopical examination* the mucosa shows some degree of leucocyte infiltration the muscularis mucosæ is slightly hypertrophied and shows interstitial fibrous changes and the submucous coat is more fibrous than normally, its blood vessels are more numerous, and lymphocyte-like cells are collected round them in great numbers. The circular muscular coat shows an extreme degree of true muscular hypertrophy being frequently four or five times its normal thickness. In old-standing cases the muscle may be replaced to some extent by dense connective-tissue fibres. If there is any overgrowth of the longitudinal muscular coat it is much less in extent than in the circular coat. The serous coat shows some degree of fibrous thickening (D P D Wilkie).

Etiology—Great difference of opinion exists as to the determining cause of these changes, and it would appear that no one of the causative factors to which the condition has been assigned is sufficient to account for all the manifestations of the disease It seems probable that a number of causes, some anatomical, others physiological, are at work. In so far as the condition is congenital, it probably arises from some defect in the sympathetic nerve supply or in the development of the parts where the hind-gut and the mid gut fuse changes similar in nature to those of congenital hypertrophy of the pylorus Given this structural change such a combination of factors as those suggested by Wilkie offers a rational and intelligible explanation of the sequence of events.

In the newly born infant the pelvic colon and its mesentery are relatively long and lax, and the mesocolon has an extensive attachment to the posterior abdominal wall so that this segment of the

bowel enjoys a wide range of mobility At birth, the lower part of the large intestine, particularly the pelvic colon is distended with meconium. If, from any cause the muscular tone of the infant's bowel is below normal, it is easy to understand how this distension may proceed to such an extent as to render the bowel incapable of *contracting on its contents and expelling them. The retained meconium* soon undergoes bacterial decomposition and fermentative gases are formed and add to the distension From the combined weight of the contents and the gaseous distension, the mobile loop of the bowel may readily become bent or kinked even to such an extent as to fold the upper end of the rectum and so occlude it, as by a valve. When the distension increases sufficiently the pelvic colon rises into the abdomen and temporarily opens the valve, and some of the contents may escape.

In its efforts, only partly successful to overcome the obstruction, the bowel wall becomes hypertrophied and thickened.

The relation which the hypertrophy bears to the dilatation *determines the fate of the case. When the hypertrophy fails to keep* pace with the dilatation, we get early obstructive symptoms with distension, and frequently death from toxæmia in infancy or early childhood. When the hypertrophy is sufficient to compensate for the dilatation the child may reach adult life, suffering only from a slightly swollen abdomen and a certain degree of constipation. Adult life being reached, compensation does not usually fail till the degenerative changes of old age begin to set in then, from fibrous changes occurring in the hypertrophied wall, compensation fails, the bowel dilates further and leads to the well known symptoms" (Wilkie)

Clinical features.—The condition is much commoner in boys than in girls, and is usually met with during the first year of life, although its recognition may be delayed till later childhood, or even till adult life.

When the compensatory hypertrophy fails to overcome the distension the symptoms appear in early infancy and tend to become acute. The most constant and characteristic symptom is obstinate constipation dating from birth, the bowels failing to move for several days at a time in spite of the free use of purgatives. When colitis supervenes, as it often does, attacks of diarrhœa may alternate with the constipation. Rectal injections usually afford temporary relief, but it is only by their constant repetition that the action of the bowels can be secured. The motions are, as a rule small, soft, and very offensive and some flatus may be passed. Occasionally small hard scybalous masses are removed by an enema.

Flatulent distension is soon manifest, the abdomen becoming pro-

minent, particularly in its upper part and the lower ribs being raised and pushed outwards, so that the abdomen appears to be lengthened in contrast with the shortened thorax. The distended coils form a pattern when a peristaltic wave passes along them and loud borborygmi are heard.

Sometimes the rectum is ballooned, sometimes it is contracted as if in a state of muscular spasm, but there is no organic obstruction. Vomiting is not a constant symptom, and it almost never becomes fæcal.

The pressure of the distended bowel upon the diaphragm interferes with respiration and with the heart's action. The patient becomes drowsy and listless, emaciates rapidly and, unless relieved, dies of auto-toxæmia or from the effects of perforation.

When the hypertrophy keeps pace with the dilatation the symptoms are less urgent. Constipation may be as obstinate but the abdominal distension is less marked, great quantities of flatus are passed, and there is seldom vomiting. The general nutrition is defective, and as the patient is constantly absorbing toxins from the colon he becomes thin, sallow and depressed. Sooner or later however compensation fails, and more acute symptoms of obstruction supervene death resulting from toxæmia or from peritonitis following perforation.

Treatment.—In early cases in which there is reason to believe that the compensatory hypertrophy is efficient, medical measures designed to improve the muscular tone of the colon and to prevent fermentation of the contents are indicated. Such drugs as strychnine, belladonna, pituitary extract, and intestinal antiseptics may be administered. The frequent and systematic use of large high enemata is of value, and it may be supplemented by abdominal massage and the use of electrical treatment.

When compensation is defective, or when medical measures have failed, recourse must be had to operative treatment, and this should be undertaken before the patient is suffering from toxæmia.

The appropriate operation can, as a rule only be decided upon after the abdomen has been opened and the actual state of affairs recognised.

When practicable, resection of the affected segment, with anastomosis of the bowel above and below is the ideal operation, but as the dilatation often extends right down to the rectum it is not often feasible. Entero-anastomosis, or short-circuiting of the bowel—the lower end of the ileum being anastomosed laterally with the pelvic colon—has so far yielded the most satisfactory results.

Colostomy affords relief in acute cases, and may tide the patient over till a more extensive operation can be undertaken. In some cases the relief afforded by a small colostomy opening acting as a

safety valve for the escape of flatus has added greatly to the comfort and safety of the patient.

Colopexy and coloplication have not yielded encouraging results and have been abandoned.

ENTEROPTOSIS

(GLÉNARD'S DISEASE—SPLANCHNOPTOSIS—VISCEROPTOSIS)

It is only necessary here to refer to the surgical aspects of this affection. A fuller description of its various manifestations will be found in works on Medicine.

Glénard, in 1885 first systematically described the condition, which consists in a sinking of the stomach transverse colon, and right kidney to a lower level in the abdominal cavity than they normally occupy Other viscera sometimes share in the prolapse.

Etiology—The displacement is probably due to a combination of causes by which the processes of peritoneum that naturally suspend the viscera become relaxed or stretched. *Among the factors* that bring this about may be mentioned weakness and atony of the muscles of the anterior abdominal wall resulting from repeated pregnancies, or following an exhausting illness compression of the thorax and abdomen by tight corsets excessive dragging on the suspensory ligaments by the weight of a dilated stomach, an over distended colon, or a tumour or the weight of an enlarged liver or spleen pushing the organs down into the lower parts of the abdomen.

Clinical features.—Enteroptosis may exist to a marked degree without giving rise to any discomfort and the severity of the symptoms is not proportionate to the degree of displacement of the viscera As a rule, however the patient complains of a constant sense of weight and a dragging pain in the abdomen and loins, aggravated by exertion and relieved by lying down, and suffers from so-called nervous dyspepsia with pain and distension after taking food flatulence and hyperchlorhydria. There is usually obstinate constipation sometimes symptoms of mucous colitis develop. In many cases all the general symptoms of neurasthenia are present to a marked degree.

On examination of the abdomen the epigastrium may be seen to be flattened, while the lower part of the abdomen is unduly prominent. By percussion, both borders of the stomach are found to be lower than normally and the natural downward bend of the transverse colon is greatly exaggerated, sometimes to such an extent that the colon reaches the pubes. As the viscera change their position with the attitude assumed, the patient should be examined successively

in the recumbent the knee-elbow and the erect position The position of the stomach and colon may be demonstrated by X ray examination

Treatment.—In mild cases, benefit follows the Weir Mitchell plan of treatment for the general neurasthenic condition and massage, electricity and suitable exercises should be prescribed to improve the tone of the abdominal muscles.

The lower part of the abdomen should be supported by a suitable belt or bandage applied while the patient is in the Trendelenburg position, and exerting pressure from below upwards.

In aggravated cases or when these measures have failed operative treatment may be considered, but when the neurasthenic element is prominent, even complete restoration of the viscera to their normal position often fails to relieve the symptoms.

Temporary benefit has followed slinging up the stomach by "reefing" the lesser omentum. The stomach and transverse colon have been fixed to the abdominal wall, and other operations have been performed to restore individual viscera to their proper position. It is probable that when benefit follows the opening of the abdomen in these cases it is largely due to the tightening up of the abdominal wall in suturing it, and special attention should always be directed to this part of the procedure

Ileo-colostomy has been recommended in severe and persistent cases, and, when pain is excessive excision of the colon.

ABNORMAL ANUS

An opening deliberately made in the bowel to enable the intestinal contents to escape is spoken of as an *artificial anus* and is to be distinguished from a *fæcal or intestinal fistula* which results from injury or disease

Artificial Anus

The most common example of artificial anus is that made in the pelvic colon to empty the bowel when it is obstructed by malignant disease in the rectum (Fig 408). Through a wound in the parietes a knuckle of the pelvic colon is brought out, and fixed by a glass rod passed through its mesentery An opening is made on the convex aspect of the bowel, with the result that both the afferent and efferent tubes present on the surface the mesenteric wall of the gut forming a septum or "spur" between them, which directs the flow out through the opening and prevents the contents reaching the distal or efferent tube When the artificial anus is to be permanent some surgeons prefer to bring out the loop of bowel, to close the abdomen around it and also as a bridge under it through a hole

made in the mesocolon and then to divide it right across so as to leave two separate openings.

An artificial anus is usually intended to be permanent, but similar openings are frequently made in this and other parts of the bowel as a temporary expedient, and when the necessity for the opening is past it should be closed. The main difficulty in effecting the closure arises from the presence of the spur between the afferent and efferent loops. This may be destroyed by crushing it between the blades of a powerful clamp or enterotome The septum or spur is defined by passing a finger into each of the tubes of bowel and one blade of the enterotome being passed along each finger the spur is crushed

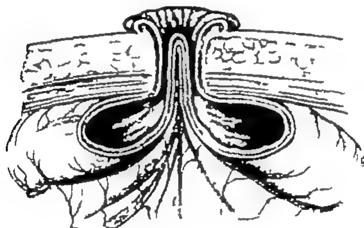


Fig 408.—Artificial anus.

by closing the instrument. It is then supported by dressings and left in position till it causes necrosis of the spur and comes away which usually happens in two to four days. The continuity of the bowel being thus restored, the external opening gradually closes.

A more certain and expeditious method is to separate the bowel from the abdominal wall by dissection, and invert the edges of the opening by sutures. The parietal wound is then closed. If it appears that the invagination of the opening in the bowel tends to narrow the lumen unduly it is better to resect the segment implicated and establish a lateral anastomosis

External Intestinal or Fæcal Fistula

An external or fæcal fistula is an abnormal track leading from the lumen of the bowel to the surface of the skin and giving exit to intestinal contents. As a rule, the opening in the bowel is a comparatively small one, and so long as the lumen of the gut beyond is

unobstructed only a small proportion of the intestinal contents escapes to the surface.

Causes.—If the vitelline duct persists as a pervious tube when the umbilical cord separates after birth, a fistulous track is left in the form of a *patent Meckel's diverticulum* (Fig 403) As a rule only a small quantity of clear mucus escapes from such an umbilical fistula and the discharge may cease spontaneously or after the lining membrane of the track has been destroyed by the actual cautery If fæcal matter escapes, the abdomen should be opened and the diverticulum excised the orifice of communication with the ileum being closed by suture.

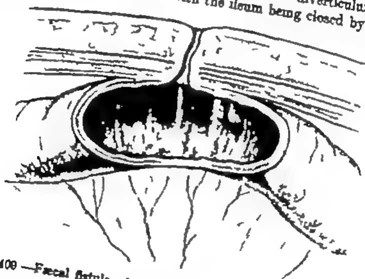


Fig 409 —Fæcal fistula bowel adherent to parietal peritoneum.

A fistula may develop *after injury* of the bowel wall—for example a contusion, a rupture or a penetrating wound—or as a result of intestinal sutures having given way If the bowel has become adherent to the parietal peritoneum before the fistula forms, the channel of communication is short (Fig 409) and is often lined by the mucous membrane of the gut which may even protrude from the opening. If on the other hand, an abscess has developed in relation to the damaged portion of bowel, and has eventually worked its way to the surface the fistulous track may be of considerable length and is lined with granulation tissue which yields a certain amount of pus (Fig 410)

Fistulæ may also originate in *ulceration of the bowel* such as sometimes occurs in tuberculous in actinomycosis, and in malignant disease or from *suppurative conditions* around it notably in appendicitis with sloughing of the wall of the cæcum, and in perforation of the gut by foreign bodies. Sometimes the inflamed appendix becomes

adherent to the parietes, and its lumen forms the track of the fistula—a condition of natural appendicostomy

Clinical features.—An intestinal fistula may be met with anywhere on the abdominal wall, and it is not always easy to determine the part of the bowel with which it communicates. If the discharge is watery and contains unaltered bile and undigested food, and if, further it causes irritation and superficial ulceration of the skin, the opening probably leads into the upper part of the jejunum. This

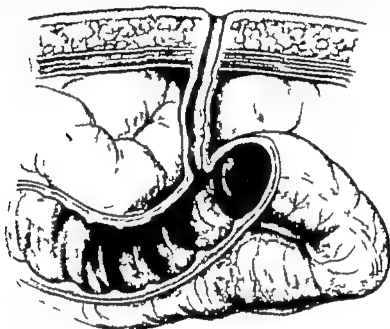


Fig 410—Fæcal fistula originating deep in the abdomen.

is rendered more probable if the patient emaciates rapidly and shows signs of starvation

The discharge from a fistula opening into the lower part of the small intestine is usually neutral or mildly alkaline in reaction, and is less irritating to the skin bile and undigested food material cannot be distinctly recognized.

The discharge from a fistula in the colon is distinctly fæcal in the cæcum it may be fluid and contain a considerable quantity of mucus in the lower parts of the colon it is solid or semi-solid.

Treatment.—It is evident that if a fistula is associated with some irremovable disease of the bowel, such as carcinoma or tuberculosis no attempt need be made to close it. If, on the other hand, it has resulted from some condition which has been overcome such as an appendicular abscess it should be dealt with.

It is to be borne in mind that those fistulæ that are lined with granulation tissue show a marked tendency to close spontaneously so long as the bowel beyond is unobstructed. If, after a reasonable time, this fails to take place the patient should be confined to bed the diet regulated so as to leave a minimum of residual material to pass through and the granulation tissue gently scraped with a sharp spoon. If there is an abscess cavity in the track of the fistula this should be opened up, and the wound packed lightly with iodoform worsted to induce it to heal from the bottom. Purgative medicines should be avoided, and the bowels emptied by enemata if necessary

When the fistula is lined by mucous membrane spontaneous closure seldom takes place, especially if there is a double loop of bowel with an intervening spur as in an artificial anus. It is then necessary to separate the bowel from the parietes by dissection, and to invaginate the aperture by sutures. If the opening is a large one and its closure by invagination unduly narrows the lumen the segment of bowel implicated should be resected and a lateral anastomosis made.

Internal Intestinal Fistulæ

As a result of disease particularly in malignant and tuberculous affections of the abdomen, fistulous communications are occasionally established between the intestine and other viscera. Sometimes an adventitious opening forms between two coils of bowel but this is serious only if the upper opening is high in the jejunum and the lower one well down the bowel in this case a long tract of the intestine is short-circuited and is lost for purposes of absorption, with the result that the patient rapidly emaciates. The stools may contain unaltered bile and imperfectly digested food materials.

A communication is sometimes established between the stomach and the transverse colon as a result of malignant disease spreading from one of these organs to the other Undigested food may appear in the stools, or fæcal matter may be vomited, with eructation of intestinal gases.

In malignant or tuberculous disease of the pelvic colon or rectum, and as a complication of chronic inflammatory diseases of the colon associated with diverticula fistulæ may form with the bladder or urethra. This not only causes great discomfort, but is attended with considerable risk to life from the spread of infection to the kidneys

A fistula may also result from the erosion of a gallstone from the gall bladder to the duodenum or sometimes to the colon.

Operative measures for the closure of such fistulæ are attended with some risk, and are only to be undertaken when the condition is endangering life and there is a reasonable prospect of curing the associated disease. The prospect of being able to cure the fistula is

greatest when it has originated in a chronic inflammatory disease of the colon with diverticula, which is now known to be the commonest cause.

INJURIES

From the clinical point of view it is convenient to divide injuries of the bowel into (1) those that are subcutaneous, and (2) open wounds—for example gunshot injuries or stabs. It is by no means uncommon for the intestine and its associated processes of peritoneum to be damaged by external violence without any evidence of injury to the abdominal parietes, and the gravity of the patient's condition only becomes manifest when the effects of the injury declare themselves in the form of peritonitis, or by symptoms of internal hæmorrhage. These injuries are often associated with lesions of other viscera, such as rupture of the liver, spleen, or kidney, or intraperitoneal rupture of the bladder.

SUBCUTANEOUS INJURIES

Etiology.—For purposes of diagnosis, it is of great assistance to obtain an accurate description of the accident, as the lesion produced depends to a large extent upon the nature, intensity, and direction of the force applied.

Subcutaneous rupture of the intestine may be due to crushing, tearing, or bursting forms of violence.

Injuries produced by crushing.—The most common cause of subcutaneous injury to the bowel is the direct impact of a blunt object against the anterior abdominal wall, for example, a kick from a horse, a blow with the fist, or a fall against a projecting object. The intestine, deprived for the moment of the protection of the abdominal muscles, which are taken unawares, is injured by being nipped between the impinging object and the bodies of the vertebræ. The centrally placed coils of small intestine—that is, those in the vicinity of the umbilicus—are most exposed to such forms of violence, particularly if the force is acting either directly backwards, or obliquely from without inwards. If the force acts in a direction away from the middle-line—downwards and outwards—the colon is more likely to be injured.

Injuries produced by tearing.—If the blow is a glancing one, acting from above, or if the body is squeezed, say, between buffers or by a wheel passing obliquely over it, the more movable segments of the bowel are driven before it, while the fixed portions, particularly the duodeno-jejunal junction, and less frequently the ileo-cæcal junction, the junction of the descending colon with the pelvic colon, or of the pelvic colon with the rectum, are liable to be torn across. Cases are

recorded in which rupture of the small intestine has been produced by the impact of a bullet which grazed the abdominal wall without penetrating it. The mesentery may be torn from the bowel for a considerable distance, sometimes for several inches.

Injuries produced by bursting.—Only in rare cases is the bowel burst by increased intra-intestinal pressure induced by violence applied from without. This may occur if, for the moment, both ends of a coil of bowel distended with gas or food are occluded, and severe force is brought to bear on the full loop. It goes without saying that if the bowel is weakened by ulceration it is more liable to be ruptured by such a form of violence.

Morbid anatomy.—In the great majority of cases the **small intestine** is the seat of rupture, and as a rule the bowel gives way only at one point. In about 10 per cent. of cases, however it is torn at several points.

The wall of the intestine may be merely *contused*, blood being effused between its coats. If the effusion is in the mucous membrane, it may lead to hæmorrhage into the lumen, with blood-stained stools or sloughing of the mucous membrane may ensue and lead to the formation of an ulcer. The lowering of the vitality of the bowel may admit of organisms traversing the walls and setting up localized peritonitis some days after the accident.

If only one or other of the coats is torn through—*incomplete rupture*—the immediate escape of the intestinal contents is prevented, but peritonitis may subsequently result, either from necrosis of the damaged portion or from the passage of organisms through it.

When all the coats are torn through—*complete rupture*—the contents usually escape at once into the general peritoneal cavity and set up peritonitis but if the tear is small and the bowel is empty at the time, the mucous membrane may protrude and plug it, and adhesions form with the omentum or with adjacent coils, and so prevent leakage. The circular muscles contract and so help to occlude the rupture and it is possible that the portion of the bowel above the lesion is paralysed, and so does not send its contents on into the damaged segment. The presence of peritonitis, therefore does not necessarily connote complete rupture of the bowel, nor does its absence necessarily indicate that the bowel has not been torn.

The **colon** is seldom ruptured by direct violence. Berry and Giuseppi collected 132 cases from the records of London hospitals during fifteen years (1893–1907). As in the small intestine, the lesion may be a complete tear or a small perforation, and the devitalized bowel may subsequently give way at one or more points.

Cases are recorded in which those portions of the colon with an incomplete mesentery have ruptured into the retroperitoneal tissues

giving rise to localised suppuration, and in some instances to surgical emphysema from the escape of intestinal gases. The colon has been ruptured by large enemata given for the relief of constipation, and by foreign bodies entering the rectum.

Clinical features.—In many cases it is evident from the general appearance of the patient that he has sustained a grave abdominal injury while in others, with equally severe lesions, there is nothing to cause anxiety The three symptoms most constantly present, which strongly suggest perforation of the bowel, are pain, vomiting and muscular rigidity

The **pain** is usually severe and persistent, and is more or less diffused over the belly but it is most intense at the site of the visceral lesion Tenderness on palpation also is usually most marked over the rupture.

Vomiting often comes on at the time of the injury continues after the stomach has emptied itself of food, and is attended by nausea. The presence of blood in the vomit indicates that the stomach or duodenum is the seat of the injury If the vomit is bilious, the small intestine is probably injured. With the onset of peritonitis, the vomiting assumes the characteristic gulping character

Muscular rigidity is the most valuable and characteristic sign, especially when accompanied by tenderness. The fixation of the abdominal walls, and the restricted action of the diaphragm, render the respiration almost entirely thoracic

At first the abdomen is retracted to the extent of being scaphoid, but later it becomes prominent either from paralytic distension of the bowel, or from the escape of gas into the peritoneal cavity The early onset of tympanites is very significant of a rupture of the bowel

Shock is sometimes so severe as to prove rapidly fatal, in other cases it is slight and evanescent, the patient may even have continued to work for some hours and been able to walk home before he began to feel ill. In these cases the first sign of the injury is the onset of peritonitis.

Dullness in the flank may be due to empty contracted bowel or to extravasated blood, but the rigidity of the abdominal muscles may prevent its recognition. If the dullness changes with the position of the patient, it is usually due to fluid blood or urine in the peritoneal cavity The dullness from fluid blood is usually most marked above the pubes.

The diminution of the area of liver dullness from the escape of gas into the peritoneal cavity is of no value, and this symptom should be ignored in forming a diagnosis, as it may be due to gaseous distension of the colon displacing the liver Emphysema of the subperitoneal tissue is rare, except in cases of rupture at the duodeno-jejunal junction or of the colon behind the peritoneum.

In the early stages the **pulse** has the character associated with shock and in the later stages, that associated with peritonitis. A rapid rise in the pulse-rate, especially if associated with a rise of temperature to 103° or 104° F., is usually of bad omen, as is also persistence of rapid superficial breathing.

Inability to pass fæces or flatus is usually present, but the patient often empties the lower bowel soon after the accident, and if the motion contains blood, an injury to the bowel is strongly suggested.

Even after a careful analysis of all the symptoms it is often impossible to be certain whether or not the bowel has been ruptured, and it is seldom possible to localize the seat of the lesion when present.

Treatment.—When the nature of the accident and the symptoms presented by the patient render it probable that the intestine has been damaged, an exploratory operation should be performed even although there is no conclusive evidence of visceral injury. Experience has shown that in many of these cases it is only when signs of peritonitis develop that a positive diagnosis can be made and that operations carried out then are comparatively seldom successful. The best results have followed operations performed between seven and twelve hours after the accident, in the interval between the passing off of the initial shock and the onset of peritonitis.

The abdomen is opened over the seat of injury if this can be determined, and the lesion in the bowel or blood vessels sought for and dealt with. If a single tear is found, it is closed by Lembert sutures inserted at right angles to the long axis of the gut. More extensive lesions necessitate resection of portions of the bowel, with lateral anastomosis. The peritoneum is then cleansed, and the abdomen closed, with or without drainage as may be found necessary.

OPEN WOUNDS

Stab Wounds

The presence of a penetrating wound of the abdominal wall always raises the presumption of a punctured or incised wound of the intestine. If the puncture in the bowel is a small one the contraction of the muscular coat may close it or the mucous membrane may protrude and prevent the escape of intestinal contents.

Nothing can be learned by exploring the external wound with the probe, and this procedure is dangerous in that it may introduce infective material deeper into the tissues, or may determine an escape of intestinal contents by opening up a puncture which has been closed by natural means or sealed off by fibrinous exudate.

The **clinical features** are similar to those of subcutaneous rupture (p. 470) and the external wound indicates the site of the

injured loop of bowel which is almost invariably immediately beneath the wound in the parietes.

The escape of gas or fæces, or the protrusion of the damaged loop of bowel through the external wound, removes all doubt as to the diagnosis, but in the absence of these signs it is often extremely difficult to decide whether the bowel has been injured or not. If the nature of the accident, the length and character of the weapon, and the position of the external wound render it probable that the bowel has been injured, an exploratory operation should always be performed at once. The existing wound is opened up and purified, the underlying coils of bowel examined, and any lesions found dealt with If the puncture is small and single, it may be closed by a Lembert suture introduced at right angles to the long axis of the bowel if more extensive, it may be necessary to resect a portion of the gut and establish a lateral anastomosis. A considerable length of the bowel should be examined, as there may be more than one wound. The peritoneum is cleansed and the parietal wound closed, suitable provision being made for drainage. *For the first few days the patient* should be kept in the Fowler position.

Gunshot Wounds

Pistol-shot wounds and wounds by *sporting guns* are sometimes met with in civil practice. The intestinal injury is a contused and lacerated wound, and often, from the scattering of small shot, or from the close range at which the weapon was discharged, several coils of bowel are damaged.

The point of entrance of the bullet may be extremely minute. In one case the writer was only able to discover it on opening up the folds of the umbilical cicatrix.

There may be considerable hæmorrhage into the peritoneal cavity from injury to a vessel in the abdominal wall, such as the deep epigastric, or from injury to the mesenteric vessels.

The **treatment** *of gunshot or pistol-shot wounds* consists in opening up the wound of entrance, and examining the whole length of the bowel. Each puncture is closed, and any contused area of bowel invaginated by a purse-string suture to prevent the risk of subsequent necrosis and leakage. It is not necessary to search for the bullet, which is usually embedded in bone or muscular tissue, where it does no harm.

INJURIES OF THE MESENTERY

The mesentery may be ruptured by violence inflicted on the anterior abdominal wall, or by penetrating wounds. Many of the fatal cases of gunshot wound of the abdomen occurring in warfare

are due to injuries of the mesenteric and omental blood vessels. As a rule other viscera are also implicated.

Profuse hæmorrhage usually takes place into the peritoneal cavity with a rapidly fatal result. Sometimes the blood is effused between the leaves of the mesentery and forms a localised hæmatoma. In a case of this kind the writer found a cake-like mass of clotted blood, about the size of the palm of the hand and nearly an inch thick, in the mesentery of a boy aged 13 about sixty hours after he had sustained a blow in the umbilical region. The clot was turned out, and the boy recovered.

The damage to the vessels may so interfere with the vascularity of the bowel that gangrene of the loop implicated ensues, and leads to a fatal result from peritonitis.

The symptoms resemble those of contusion or rupture of the bowel but the signs of internal hæmorrhage are superadded.

The only **treatment** is to open the abdomen and secure the vessels. The tear in the mesentery should be closed, lest it form an aperture through which the bowel may subsequently pass and be strangulated.

FOREIGN BODIES IN THE INTESTINE

The great majority of foreign bodies that have been swallowed and have successfully passed the pylorus, safely traverse the remaining segments of the alimentary canal and are passed by the rectum. The facility with which large and irregular objects pass along the intestinal canal is remarkable.

In its passage along the bowel, a foreign body may become encrusted with fæcal matter and phosphates, and, while this may add to the bulk of the object, it at the same time renders its passage safer by rounding off sharp angles or filling up crevices and hooks, as, for example, in the case of a small tooth plate. Some metallic objects undergo a certain degree of solution, while organic bodies, such as bones, may be partly digested. The use of the X rays facilitates the localisation of many foreign bodies.

Clinical features.—*The passage of a foreign body along* the intestine is seldom attended with any symptoms beyond slight colicky pain and occasional vomiting. The time taken for an insoluble body to traverse the bowel varies from forty-eight hours to two or three weeks. Irregular bodies are sometimes temporarily arrested and cause localised irritation of the mucous membrane with symptoms of enteritis, in the form of fever, severe griping pain and tenderness, distension, and diarrhœa with pus and blood in the stools.

As the most common site of arrest is in the lower part of the ileum, at the ileo-cæcal valve, or in the cæcum, the local symptoms are

generally referred to the right iliac fossa. If the body is long detained localized peritonitis may ensue with muscular rigidity of the abdominal wall over the site of arrest. Foreign bodies may be permanently arrested at the narrowest part of the gut—that is, the ileo-cæcal region—or by a stricture of the bowel, the most common cause of which is malignant disease of the colon. In a few recorded cases, a foreign body has been arrested in a hernia or in a pouch or diverticulum of the bowel.

Only in rare cases does a foreign body arrested in a normal portion of the bowel cause obstruction, but when the lumen is narrowed by disease and becomes occluded by an object such as a fruit stone, a piece of bone or a gall-stone acute symptoms may supervene. The more serious effects of permanent arrest are due to septic complications following enteritis and ulceration, and ending in perforation. Cases have been recorded in which localized peritonitis has led to abscess formation, and the foreign body has passed into the abscess and escaped through the abdominal wall. In other cases the object has found its way into the bladder or other viscus.

Treatment.—To facilitate the passage of a foreign body along the intestine the patient should be fed on such foods as porridge, pease-brose, or vegetables which leave a considerable residue. In the case of such bodies as tooth plates, small lockets, or other objects with hooks or projections, it has been found useful to mix with the food a moderate quantity of chopped up string, which by the churning action of the stomach, is wound round the projections and prevents them catching on the mucous membrane In the great majority of cases there is no call to operate unless serious symptoms threaten. If a skiagram is taken to locate the foreign body and operation is decided upon, this should be done at once, as the body may change its position if there is any delay

INTESTINAL OBSTRUCTION

The term intestinal obstruction is a purely clinical one, and implies an interference with the passage of the bowel contents along the canal. The extent of the arrest varies widely from a slight difficulty in obtaining a regular evacuation to sudden and complete arrest of the passage of fæces and flatus.

The primary cause of the obstruction is usually mechanical, and several different mechanisms may be responsible. For example, the lumen may be gradually narrowed by cicatricial contraction, resulting in a variable degree of stenosis the bowel may be blocked by a tumour of the wall gradually filling it up or one segment of

[1] I desire here to express my indebtedness to the writings of the late H. L. Barnard.

bowel may be invaginated into another as in intussusception. When due to such causes the obstruction is incomplete but progressive. Again, a loop of bowel may be twisted on its mesenteric axis as in volvulus or be snared by a fibrous band the margins of an aperture in the mesentery or the neck of a hernial sac. Under these conditions, not only is the lumen immediately occluded and the obstruction at once rendered complete but the blood vessels of the segment implicated are also occluded, and the nerve supply interfered with, so that the vitality of the bowel is endangered. To this condition the term strangulation is applied

Whatever the mechanical cause may be sooner or later the nerve mechanism governing the peristaltic action of the bowel is interfered with, and a paralytic factor comes into play adding to the difficulty the bowel has in emptying itself.

In certain forms of obstruction, notably that associated with generalised peritonitis the cause is inherent in the bowel itself consisting in a loss of muscular contractility—*paralytic obstruction.*

It is convenient to classify cases of obstruction of the bowel under the headings—(1) Acute or Sudden Obstruction (2) Chronic or Gradual Obstruction and (3) Chronic Obstruction becoming Acute

1 Acute or Sudden Obstruction

Acute obstruction is always a serious condition, and is attended by a group of symptoms of which the most obvious are abdominal pain persistent vomiting distension with complete cessation of the passage of intestinal contents, and a greater or less degree of shock The earliest of these symptoms—pain, vomiting, and shock—are not peculiar to obstruction but are common to all acute abdominal affections, and are probably attributable to a profound impression made upon the sensory nerves of the abdomen rather than to the mere interference with the transmission of the bowel contents.

After the obstruction has lasted for some time, the patient passes into a condition of collapse and the general circulation is profoundly affected the heart's action becoming weak and rapid as a result of the absorption of toxic material from the stagnating contents of the bowel above the seat of the block. At this stage the relief of the obstruction may not suffice to save the life of the patient as the amount of poisonous material absorbed may be so great as to prove fatal It is evident therefore that, once a diagnosis of obstruction has been made operative treatment should be undertaken at the earliest possible moment to prevent the patient absorbing a fatal dose of toxins, and that no operation is complete that does not ensure a speedy evacuation of the segment above the block so that no further absorption may take place.

Pathology and morbid anatomy.—The most severe forms of acute obstruction are those due to sudden and complete occlusion of the bowel, *as when a loop is impacted in a hernial aperture, or is* snared by a band, or rotated on its mesentery because not only is the passage of flatus and fæces completely arrested, but the vessels supplying the strangulated segment are occluded and the nerve supply interfered with.

The immediate effect of the strangulation is to excite a violent peristalsis, which results in forcing on the contents of *the segment below the obstruction*, so that this portion is emptied and passes into a condition of spasm. When seen a few hours after obstruction has begun, it is pale, contracted, and empty and when handled, it feels firm. It is neither collapsed nor paralysed

The segment above the obstruction rapidly becomes distended with intestinal fluids and gases. The fluids consist of liquid fæces, an excessive secretion of the glands of the alimentary canal inflammatory exudate, and blood. When the disturbance of the circulation *is so great as to interfere with absorption of gas from the intestine*, the distension is added to by accumulation of flatus and by bacterial decomposition of the intestinal contents. At first the walls are thin and pale, but in the course of a few hours they become deeply congested and œdematous, and the mucous membrane may show hæmorrhages and superficial erosions.

Distension is greatest when the small intestine is obstructed, because secretion of a considerable amount of fluid is reflexly stimulated. The distension gradually spreads upwards and may reach the duodenum or even the stomach. When the pelvic colon is the seat of the obstruction, the distension is less, because the higher reaches of the colon continue to absorb fluid

In course of time, the surface epithelium of the mucous membrane is shed, and organisms pass through the wall and reach the peritoneal cavity giving rise to peritonitis. Minute sharply circumscribed ulcers *may form as a result of necrosis of the mucous membrane*, and these may lead to perforation (Kocher) Sometimes there are multiple pin point perforations scattered over a segment of bowel.

The *strangulated coil* becomes deeply congested from interference with its venous return. At first, unless the strangulation is very tight, the arteries are not occluded, and they continue to force blood into the veins, with the result that the congestion is increased. The bowel becomes deep purple in colour tense and œdematous, and blood-stained serum exudes into the lumen and the peritoneal cavity

If the strangulation is so acute as to occlude the arteries at once, the affected segment is pale, grey or green [illegible] ccid and it becomes gangrenous within a few hours. The [illegible] nt is distended

with gas, which is probably carbon dioxide that cannot be absorbed by the veins, and the distension may be enormous—for example, in volvulus of the pelvic colon. The tension of the strangulated coil is, as a rule much greater than that of the distended bowel above the obstruction The strangulated loop soon loses its power of preventing organisms passing through its wall and in this way early infection of the peritoneum may take place. Sooner or later gangrene ensues from thrombosis of the vessels, and perforations of various sizes occur leading to peritonitis.

Clinical features.—The clinical features of acute obstruction vary considerably according to the cause, but certain symptoms are common to all cases, whatever the cause and these may be considered here

It is to be borne in mind that obstruction itself is not the essential or all-important cause of the symptoms. The initial symptoms are evidence of " peritonism, or shock inflicted through the peritoneum the next to follow are due to interference with the onflow of the intestinal contents those of the later stages are signs of the absorption of toxins from the stagnating contents or from peritonitis.

As a rule, the onset is sudden, the patient having had no previous discomfort or feeling of illness, and it is seldom possible to attribute the condition to any exciting cause The first symptom is intense abdominal pain which is usually so severe as to double the patient up or cause him to writhe in agony on the floor When the small intestine is implicated the pain is continuous, and is referred to the umbilical region. The higher up in the intestine the strangulation occurs, the tighter the constriction, and the greater the extent of bowel implicated the more severe is the pain. Hyperalgesia is usually too diffuse to aid in localising the seat of the lesion.

When the obstruction is in the colon the pain is referred to the hypogastric region.

After a time, when the nerves of the strangulated segment become exhausted, or when perforation occurs and the tension in the loop is relieved by the escape of gas and fluid, this initial pain may be temporarily alleviated.

Sooner or later however severe griping pain is experienced from the excessive peristaltic efforts of the bowel to force its contents along the tube. As the muscular coats become exhausted, this pain to some extent abates, and the relief may be contributed to by the poisoning of the nerve mechanism with toxins derived from the stagnating contents. The paralysis thus induced may prevent the bowel from emptying itself even if the obstruction is removed. Up to this point the pain is not increased, and may even be relieved, by pressure, and there is no marked rigidity of the abdominal muscles.

Unless the obstruction is relieved, organisms pass through the wall of the gut and set up peritonitis and this is associated with a characteristic stabbing pain, which is increased by pressure, and attended by rigidity of the abdominal muscles. In cases of extreme toxæmia, the abdominal muscles may relax and the tenderness disappear—symptoms of grave omen.

Vomiting almost always commences within a few hours of the onset of the pain. This early vomiting is a reflex symptom due to interference with the sympathetic nervous system, and is, as a rule, proportionate to the severity of the pain. It is attended with nausea, retching, and eructation, and affords no relief to the patient's suffering. *It occurs independently of the taking of food, and is continuous* and persistent. The vomited matter consists at first of the stomach contents later it contains a large admixture of bile which appears to be excreted in excessive quantities, and is permitted to enter the stomach by the relaxation of the pylorus induced by the alkalinity of the bile (Pavlov) As time goes on the character of the vomiting changes and assumes the characteristic regurgitant or gushing type, in which mouthfuls of dark brown or yellowish fluid are brought up without retching or effort. The fluid has a highly offensive odour resembling that of fæces, but is not really fæcal in character The odour is due to bacterial decomposition of the intestinal fluids accumulated above the obstruction, and may be as marked in cases in which the obstruction is high up in the jejunum as in obstruction of the large intestine. In fact regurgitant vomiting occurs earlier and is more severe the nearer the obstruction is to the stomach and it is often entirely absent when the colon is the seat of the obstruction.

The third symptom characteristic of the onset of acute obstruction is **primary shock** which is usually well marked within a few hours and is at first due to the profound impression made upon the sympathetic and other nerve-fibres distributed in the abdomen. Later the patient passes into a condition of **secondary shock**, which is aggravated by the loss of fluid from persistent vomiting and sweating, and by intoxication from absorption of toxins formed in the *decomposing contents of the bowel above the obstruction.* The face is pale, the eyes are sunken, the pulse is rapid, feeble and thready the respiration shallow and sighing, and the temperature persistently subnormal. The skin is covered with a cold, clammy sweat. The hands, the feet and the tips of the nose and ears become cold, blue, and shrivelled, and there is persistent, insatiable thirst. The patient often suffers greatly from cramps, especially in the calf muscles. He usually remains conscious indeed, is often abnormally alert, even to the very end, and fails to realise the gravity of his condition

Frequently a motion is passed just after the onset of pain and

vomiting, the lower bowel being emptied by spasmodic contraction of the segment below the obstruction. Thereafter there is complete arrest of the passage of fæces and flatus, and the patient has no desire to defæcate except in those cases in which the bowel is strangulated low down, when there may be tenesmus. Enemata are often retained and if returned the fluid flows away without force and unaccompanied by fæces or flatus.

The presence of indican in the urine is fairly common in cases of acute obstruction, but it is not characteristic of this condition as it may be a symptom of other acute affections. It is due to bacterial decomposition of proteins resulting in the formation of indol in the small intestine which is excreted by the kidney as indican. This symptom is most marked in obstruction of the small intestine and is generally not present till the second or third day.

An examination of the abdomen in the early stages, as a rule gives little information. The belly is usually flat, flaccid and not tender. Later it is more prominent and when peritonitis begins it becomes rigid.

Tympanites occurs to a greater or less extent in all forms of acute obstruction, but is most marked in obstruction of the large intestine, particularly in volvulus of the pelvic colon. Distension of a single loop of bowel is of no value in localizing the seat of the obstruction.

In primary acute obstruction peristaltic waves are seldom visible unless the patient is extremely emaciated. In the acute phase of a gradually increasing obstruction, they are often prominent and of diagnostic value.

Except in cases of intussusception or of obstruction by foreign bodies or fæcal concretions, a localized tumour can rarely be palpated in the abdomen.

Differential diagnosis.—The initial symptoms of acute intestinal obstruction so closely resemble those of other acute abdominal conditions that it may be extremely difficult to distinguish between them. Among the possibilities that have to be considered at this stage are: (1) Acute appendicitis, (2) perforation of a gastric or duodenal ulcer, (3) rupture of a pyosalpinx or extra-uterine gestation, (4) rotation of the pedicle of an ovarian or uterine tumour, (5) acute pancreatitis, (6) embolism or thrombosis of the mesenteric vessels, (7) various forms of colic—biliary, renal, or intestinal.

By the time the symptoms characteristic of interference with the passage of the intestinal contents come to predominate it is usually possible to exclude most of these conditions and the question left for decision is the cause of the obstruction. A consideration of all the available clinical data may enable a correct opinion to be formed in

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many cases, but in others it is impossible to do more than make an intelligent guess as to the cause of the symptoms

In the infant, the most likely causes are (1) Strangulated external hernia (2) intussusception, (3) one or other form of retroperitoneal hernia, (4) congenital abnormalities of the rectum or intestine. **In the child** over two years of age, the possibilities are (1) Strangulated external hernia (2) intussusception (3) strangulation by Meckel's diverticulum, (4) strangulation by bands or adhesions, particularly if there is a history of tuberculous peritonitis, appendicitis, injury or a previous operation (5) retroperitoneal hernia. **In the adult,** (1) strangulated external hernia, (2) volvulus, (3) strangulation by bands or through apertures, (4) retroperitoneal hernia (5) impaction of a gall-stone or a fæcal concretion and (6) pressure of tumours external to the bowel are among the primary causes of acute obstruction. It is possible that a gradual narrowing of the bowel by cicatricial contraction or by the growth of a malignant tumour may culminate in complete obstruction without any premonitory signs of stenosis. **In the aged,** acute obstruction is usually due to (1) sudden blockage of the narrowed lumen in malignant disease of the colon (2) strangulated external hernia (3) intussusception, or (4) fæcal accumulation

Diagnosis of the site of the obstruction.—The clinical distinctions between obstruction in the small intestine and in the colon are by no means well marked It may be said generally that the onset of obstruction in the small intestine is more acute, the initial shock is greater the pain more intense and the vomiting more copious and persistent than when the colon is blocked. The illness tends to run a more rapid course and the vomiting becomes stercoraceous sooner

Tympanites is more marked when the colon is the seat of the obstruction, and the dilated colon may be recognizable. The patterns formed by the distended bowel the evidence afforded by percussion, and the situation of pain, are of no constant value in fixing the seat of obstruction.

Treatment.—Only when the patient's sufferings are extreme, and there is good reason to believe they may be due to some form of colic, should opium be administered in suspected cases of obstruction If a single moderate dose of morphia, combined with atropine, fails to relieve the pain no more should be given and if a definite diagnosis cannot be arrived at arrangements should be made for an immediate exploratory operation. Meanwhile a turpentine enema should be administered, the patient lying on his left side with the pelvis raised. Nothing should be given by the mouth, except occasional sips of warm water The use of ice is to be avoided.

Exploratory laparotomy.—Before the anæsthetic is administered the stomach should be washed out, and if the patient is unable to empty the bladder a catheter should be passed. The abdomen is opened below the umbilicus through the medial edge of one or other rectus. The primary incision should only be large enough to admit two or three fingers, and after the cavity has been explored it can be enlarged upwards or downwards as may be necessary. The cæcum is first examined, and if it is found distended, the colon should be traced down. If it is empty the obstruction is probably in the small intestine. If a portion of empty and contracted small intestine is discovered, it should be traced upwards till it meets distended bowel at the seat of the lesion. If nothing but distended bowel can be found it is probably safest to secure the lowest loop that can be reached, and make a temporary artificial anus in it; when the bowel has been emptied and the patient tided over the dangerous period, a second operation may be done to discover and deal with the cause of the obstruction. Every endeavour should be made to prevent coils of distended bowel escaping from the peritoneal cavity, as experience shows that this greatly diminishes the patient's chance of recovery even when the cause of the obstruction is found and removed.

When the cause of the obstruction is readily accessible and has been removed, if the bowel above is greatly distended it may be emptied, as suggested by Moynihan, by opening it and passing a straight glass tube over which long stretches of the gut may be pulled. This measure, however, is seldom beneficial.

The methods of dealing with the various lesions which cause obstruction will be referred to later.

2. Chronic or Gradual Obstruction

The freedom with which the bowel contents pass along the tube may be gradually interfered with in a variety of circumstances. In the great majority of cases the interference occurs in the colon, and is due to mechanical causes, such as the growth of a tumour in the bowel wall slowly encroaching upon the lumen and narrowing it, the cicatricial contraction of inflammatory adhesions constricting, kinking, or binding down the bowel, or the pressure of an extrinsic tumour interfering with the peristaltic action of the gut or narrowing its lumen.

In these circumstances, either there is no disturbance of the vascular and nervous mechanism of the affected portion of bowel, or this is a factor of secondary importance and one which only comes into play late in the progress of the disease.

Sooner or later, if left alone, the interference with the function of the bowel becomes so great that symptoms of acute obstruction supervene, and in many cases the crisis comes on suddenly from some

superadded complication. This phase will be considered separately (p. 483) as the clinical procedure is different.

Pathology and morbid anatomy—*Gradual obstruction* is seen in its most typical form in malignant disease of the colon, in which without completely occluding it the growth gradually narrows the lumen of the bowel, either by filling it up or by cicatricial contraction, or by a combination of these processes.

In those portions of the bowel—the small intestine and the higher parts of the colon—in which the fæces are fluid, a considerable degree of narrowing may exist without appreciable interference with the onflow and there are no secondary structural changes in the bowel of any importance or only a moderate degree of dilatation. When the narrowing has progressed sufficiently to interfere with the onward passage of the contents, the segment *above the seat of the obstruction* becomes distended, its walls, particularly the muscular coat are hypertrophied as a result of prolonged and repeated attempts to force the passage and the tube becomes elongated and tortuous.

Hypertrophy is most marked in the *small intestine* the circular muscular fibres increasing in size and number so that the wall becomes thicker and firmer than normal (Fig. 436 p 545)

In the colon, dilatation is more prominent than hypertrophy and in some conditions may reach extreme limits, the diameter of the bowel being as much as a foot (Fig. 407 p 458).

The mucous membrane is irritated by the products of decomposition in the stagnating contents, and is in a condition of chronic catarrh. Ulceration supervenes either as a result of the action of toxins on the inflamed and stretched mucous membrane—the distension ulcers of Kocher or from the pressure of hard fæcal masses in the lower colon—so-called *stercoral ulcers* (Fig 430, p. 533). The ulceration may extend through the bowel and lead to peritonitis, or to suppuration in the retroperitoneal tissue.

So long as the vascular mechanism of the bowel is intact gases do *not* collect in the dilated portion, as they are absorbed *into* the circulation, or pass through the narrowed lumen into the bowel beyond.

The segment *below the obstruction* is pale and contracted and, as a rule empty although in some cases the fæcal matter that escapes past the obstruction collects in the lower segment and may form a considerable mass there and the bowel may even be moderately distended with gas.

Effects on the mesentery.—As it gradually becomes more and more distended, the bowel may force its way between the layers of its mesentery so that this structure is appreciably shortened. Then the affected segment of bowel becomes abnormally fixed, and this may interfere with such operations as colostomy by rendering it

difficult to bring the pelvic colon to the surface. If the stretching process continues, the peritoneum covering the bowel may split in the long axis of the gut— striation of the mesentery

Clinical features.—The symptoms of chronic obstruction come on insidiously and, from the way in which they are produced, the progress of the malady is often irregular and intermittent. There are periods, sometimes lasting for days or even weeks, during which the patient has little difficulty with the bowels, followed by others in which a satisfactory evacuation is only obtained by taking strong purgatives or with the aid of enemata.

The early symptoms—a feeling of discomfort or a moderate degree of pain and occasional attacks of vomiting, particularly after taking food, and a more or less constant feeling of uneasiness in the abdomen —are usually attributed by the patient to indigestion. There is great complaint of flatulence which the patient has difficulty in getting to pass downwards. Either these symptoms are neglected, or treatment is directed towards the stomach Morning diarrhœa—that is, passage of a fluid stool immediately on getting up—is a common and characteristic symptom of cancerous obstruction of the lower colon

As time goes on, the patient finds a difficulty in securing a regular and satisfactory evacuation of the bowels, and succeeds in doing so only by taking purgatives, the dose and frequency of which require to be increased without, however being followed by a corresponding result. Eventually the medicine has no effect on the bowels, and only induces attacks of severe griping pain which may be accompanied by vomiting, and are often relieved by making pressure on the abdomen or by rubbing it. Sometimes the pain is increased by pressure. When the obstruction is in the colon the patient is often able to locate it fairly accurately by the point at which the pain reaches the maximum during a spasm of colic.

There is often a history of attacks of diarrhœa in which a small quantity of fæcal matter mixed with a considerable amount of mucus is passed and these attacks are attended with great straining and are not followed by any feeling of relief. They are due to catarrhal inflammation of the mucous membrane set up by the fæcal masses retained above the seat of obstruction. As a rule, these attacks of spurious diarrhœa alternate with periods of marked constipation —a combination of circumstances which is very characteristic of chronic obstruction of the colon.

Gradually the bowel above the obstruction is distended and hypertrophied, the abdomen becomes more prominent and visible peristaltic waves may be observed to pass along the gut from time to time Visible peristalsis is perhaps the most certain clinical indication of chronic obstruction.

On rectal examination, it is frequently found that, after passing through the anal canal, the finger enters a wide open space, the walls of which it is difficult to reach. When touched, the mucous membrane is smooth, the rugæ having disappeared, and the rectum appears to be *unduly fixed*. This condition known as "ballooning of the rectum," is due to paralysis of the gut, and is most frequently met with in cases of stenosis of the descending and pelvic portions of the colon



Fig 411 —Dilated coils of small intestine forming ladder or "organ-pipe pattern, from a case of chronic tuberculous peritonitis with adhesions.

(From Treves I ntestinal Obstruction.")

When the small intestine is chronically distended, the contracting coils stand out as a series of tubular prominences running across the abdomen, suggesting the appearance of the rungs of a ladder or a set of organ pipes— ladder or organ-pipe pattern (Fig 411) When the distension affects principally the large intestine, the different parts of the colon may be recognised to be distended, but they seldom exhibit peristaltic waves so distinctly as does the small intestine (Fig 412)

These waves of peristalsis are accompanied by attacks of colicky pain, and often by loud rumbling or gurgling sounds, spoken of as stenosis noises or "borborygmi," and on palpation the contracting loop of bowel is felt to become firm and rigid.

Gradually the symptoms become more severe and continuous. The digestion is seriously disturbed, the tongue and mouth become coated, the breath has an offensive fæcal odour and the patient is poisoned by toxins absorbed from the stagnant and decomposing contents of the gut. Symptoms of collapse are present only when there is a marked degree of toxæmia. Finally death results either from the toxæmia and exhaustion induced by it, or from the sudden occurrence of perforation and peritonitis.

Diagnosis.—There is no difficulty in recognising that the patient is suffering from chronic obstruction, but it may not be

easy to form an opinion as to the cause A careful analysis of all the clinical features, including the history usually throws some light on the question. The following are among the possible causes In the child (1) Adhesions associated with tuberculous or other forms of peritonitis, (2) tuberculous disease of the bowel or mesenteric glands followed by cicatricial stenosis, (3) chronic forms of intussusception (4) Hirschsprung's disease. In the adult (1) Peritoneal adhesions, (2) cicatricial strictures, (3) malignant disease, (4) ileo-cæcal tuberculosis, (5) fibromatosis of the colon (6) actinomycosis (7) primary chronic intussusception, (8) pressure of extrinsic tumours. In the aged (1) Malignant disease (2) chronic intussusception (3) fæcal concretions, (4) fæcal accumulation.

The **treatment** of chronic obstruction depends upon the lesion causing it, and will be described later

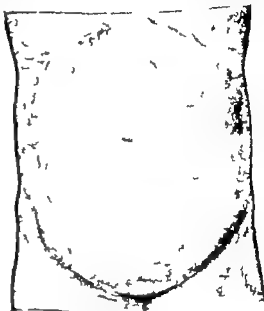


Fig 412—Dilatation of pelvic colon above a stricture.

(From Treves' "Intestinal Obstruction.")

3. CHRONIC OBSTRUCTION TERMINATING ACUTELY

One of the most common terminations of gradually increasing stenosis of the bowel is the onset of symptoms of acute obstruction brought about by sudden occlusion of the narrowed lumen. This may be due to a hard fæcal mass, a gall-stone or a foreign body blocking the aperture or to congestion of the mucous membrane following the taking of a strong purgative. In other cases it results from kinking or torsion of the affected segment brought about by rapid distension with gases, or by a sudden change of position. In advanced cases the bowel may be exhausted by its attempts to overcome the obstruction, and become relaxed or even paralysed.

The changes in the bowel present a combination due to the gradual obstruction with the superadded effects of complete occlusion in the form of increased vascular engorgement and gaseous distension.

Unless relieved by operation the condition usually terminates fatally either by exhaustion induced by pain and vomiting, and interference with the action of the lungs and heart due to the distended bowel pressing upon the diaphragm, or by peritonitis set up by organisms passing through the wall of the gut or from perforation.

RETROPERITONEAL HERNIA

In the early embryo the intestinal canal consists of an almost straight tube attached to the middle line of the body by a fold of peritoneum—the primitive mesentery As the different segments of the alimentary canal and the associated secretory glands are differentiated and assume the dimensions and position of the fully developed organs, this mesentery undergoes a corresponding series of changes, certain parts becoming elongated, while others become shortened and fixed. Without going into details, it may be said that, as a result of these and other changes, various peritoneal folds with intervening fossæ are developed on the posterior abdominal wall particularly in relation to the flexures of the intestinal canal The surgical significance of these fossæ lies in the fact that they may assume such dimensions as to form potential sacs into which a loop of bowel may pass and become strangulated.

The situations in which such retroperitoneal hernias may occur are—(1) at the termination of the duodenum (2) in the vicinity of the cæcum and appendix (3) in the mesentery of the pelvic colon. Hernia into the foramen of Winslow and diaphragmatic hernia, although not strictly retroperitoneal, are for convenience included in this section.

Duodenal Hernia

Numerous fossæ have been described in relation with the duodeno-jejunal junction. The most important for our present purpose is the *paraduodenal fossa*, which is situated on the left side of the ascending portion of the duodenum. Its left border is formed by the inferior mesenteric vein and its right by the duodeno-jejunal flexure Its orifice looks downwards and to the right, its blind extremity being directed upwards and to the left. Into this fossa, the *left* form of duodenal hernia passes, and as it increases in size it extends down behind the transverse and descending colon.

The next most important is the *mesenterico-parietal fossa*. This lies in the mesentery of the jejunum, immediately below the duodenum, and behind the superior mesenteric artery which forms its anterior boundary Its orifice looks to the left, and its base downwards and to the right, and into it the *right* form of duodenal hernia passes, extending down behind the transverse and ascending colon.

Clinical features.—Duodenal hernia has been met with at all ages some of the recorded cases have occurred in infants. Its presence is never suspected unless strangulation has occurred, and even then, in the vast majority of cases the cause of the obstruction has only been discovered on opening the abdomen.

The symptoms that may suggest the presence of a duodenal hernia are long-continued dyspepsia and irregularity of the bowels with colicky pains, and the presence of a circumscribed globular swelling, resembling a movable cyst, except that it is resonant on percussion and yields intestinal sounds on auscultation. Owing to the compression of the inferior mesenteric vein at the neck of the fossa, the patient usually suffers from piles which bleed freely

When *strangulation* ensues, all the symptoms of acute obstruction are present and as it is usually the first part of the jejunum that is implicated profound shock and persistent vomiting are prominent symptoms.

Treatment.—When on opening the abdomen in a case of obstruction, the cause is found to be a strangulated duodenal hernia, the bowel must be withdrawn from the fossa without dividing the neck of the sac, in which runs the inferior mesenteric vein or the superior mesenteric artery An attempt should be made to close the opening into the fossa by suturing its margins, and so prevent recurrence of the hernia.

Pericæcal Hernia

Several fossæ are present in the vicinity of the ileo-cæcal junction the most important from the surgical point of view being the *ileo-appendicular* which lies between the ileo-appendicular or "bloodless" fold of Treves and the mesentery of the vermiform appendix and the *retrocolic*, lying behind the cæcum and the lower part of the ascending colon.

The existence of a hernia into one or other of these pouches is never recognized unless strangulation occurs, and then the symptoms are those of acute obstruction. Usually the hernia can readily be withdrawn from the sac, and the obliteration of the pouch is facilitated by removal of the appendix.

Hernia of the vermiform appendix alone into a fossa is not uncommon, and, if the appendix becomes strangulated, symptoms of acute appendicitis develop.

Intersigmoid Hernia

This extremely rare form of hernia passes into the *intersigmoid* fossa which is formed by the layers of the mesentery of the pelvic colon over the bifurcation of the common iliac artery and near the

inner margin of the psoas muscle. The sigmoid vessels run in the fold of peritoneum which forms its anterior margin.

Hernia into the Foramen of Winslow

Hernia through the foramen of Winslow is very rare, and is only possible when the foramen is exceptionally large owing to some congenital abnormality

When strangulation occurs, the usual signs of acute obstruction are present, the pain being intense and situated in the epigastrium, and a swelling, which is dull on light percussion but gives a resonant note on deeper percussion, can usually be made out. It is a curious fact that there is no evidence of pressure on the hepatic vessels or bile-duct, which run in the margin of the foramen

The **treatment** consists in opening the abdomen and withdrawing the strangulated coil As the structures in the margins of the foramen forbid division of the constricting agent, if reduction cannot be effected by traction the lesser sac of the peritoneum must be opened through the gastro-hepatic or gastro-colic omentum, and the distended bowel withdrawn and emptied. After the opening in the bowel is sutured, it is returned to the lesser sac and withdrawn through the foramen

Diaphragmatic Hernia

This term is applied to any protrusion of the abdominal contents through the diaphragm, although in nearly 90 per cent. of cases there is no peritoneal sac, and the condition is rather one of prolapse than of true hernia.

Morbid anatomy.—The protrusion may take place (1) through one or other of the natural openings in the diaphragm, particularly that for the œsophagus (2) through a congenital deficiency in the muscle (3) through a tear produced by indirect violence or muscular effort or (4) through a direct wound of the muscle.

The condition is usually met with on the left side, where the diaphragm lacks the support of the liver. The size of the opening varies from a mere slit in the tendinous portion of the diaphragm to a complete absence of one half of the muscle.

As a rule the viscera are prolapsed into the left pleural cavity and the organs most frequently implicated are the stomach, the colon, and the small intestine The liver pancreas, spleen, and left kidney have also been found in such hernias.

The majority of cases of congenital diaphragmatic hernia have been met with on post-mortem examination of still born children, or *of infants who have only survived a few days.* Others have been found at the autopsy of adults who have never manifested any clinical signs

of such a condition. In cases of traumatic origin, signs may develop soon after the injury or not till long after

Clinical features.—The condition has seldom been accurately diagnosed during life. As the stomach is almost always present in the hernia, gastric discomfort constitutes the chief complaint, and the patient may be conscious that the food lodges in the region of the chest, where it produces a fixed pain.

On examination an unnatural depression in the epigastric and left hypochondriac regions may be noted with a corresponding fullness in the lower thoracic region. The thoracic signs are similar to those of pneumothorax, but are detectable chiefly in the lower part of the chest and distinct intestinal gurgling may sometimes be heard on auscultation. The heart may be displaced and its action interfered with, causing palpitation, attacks of dyspnoea and oppression in the chest, with inability to lie on the left side.

These symptoms are influenced by the taking of food or fluid and sometimes by exertion, and the rapid variations in the physical signs help to differentiate this condition from pneumothorax.

Information can be obtained by taking an X ray photograph after administering an opaque meal or injecting bismuth emulsion into the colon.

When the hernia is suddenly produced there is intense dyspnoea and cyanosis, with severe praecordial pain and oppression, and the condition may rapidly prove fatal from shock or from compression of the lung

Strangulation is associated with all the signs of acute obstruction It may be determined in an old-standing hernia by some sudden and violent muscular effort, or by a crush of the body In traumatic cases the bowel may become strangulated at the moment it passes through the rent in the diaphragm.

Treatment.—In *recent traumatic cases* an attempt should always be made to replace the prolapsed viscera in the peritoneal cavity The rent in the diaphragm must be closed by suture and to effect this it may be necessary to enlarge the wound and even to resect portions of one or more ribs.

When *strangulation* has occurred and the hernia is discovered on opening the abdomen, before any attempt is made to reduce it the pleural cavity should be opened by a U or T-shaped incision, with resection of ribs, to avoid the risk of pulling a gangrenous or perforated loop of bowel into the peritoneal cavity to enable the pleural cavity to be purified and drained, and to facilitate the subsequent closure of the opening in the diaphragm.

To avoid the risks of pneumothorax incident to free opening of the pleural cavity anaesthesia should be induced by intratracheal insufflation of ether

PERITONEAL ADHESIONS

All varieties of inflammation of the peritoneum are liable to be followed by the formation of adhesions between adjacent serous surfaces. In certain circumstances—for example after surgical operations on the bowel, as a sequel to drainage of the peritoneal cavity in cases of gastric or intestinal ulcers, cholecystitis, or disease of the mesenteric glands—the adhesions are confined to the vicinity of the irritant, and may only persist as long as the irritation lasts, serving a protective purpose and being absorbed when they are no longer required. On the other hand as a sequel to such conditions as generalised septic or tuberculous peritonitis, the adhesions may involve the whole of the peritoneal membrane matting the intestines into an inextricable mass, and fixing the viscera to one another and to the parietal peritoneum.

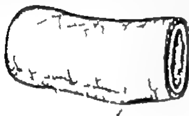




Fig 413. — Illustrating the formation of a fibrous band between two coils of small intestine.

(*Museum Royal College of Surgeons Edinburgh.*)

Between these extremes all degrees are met with, and the adhesions may take the form of broad thin sheets of fibrous tissue stretching between adjacent coils of bowel (Fig 413) or narrow strands fixing one short loop to another or they may be moulded into long cord like bands passing from one part of the abdominal cavity to another

The effect of adhesions on the function of the bowel bears no direct relation to their extent or disposition, and it is remarkable how little disturbance may result even when the whole intestine is matted into what appears to be a solid mass. When adhesions do give rise to symptoms, these may take the form of repeated attacks of colicky pain with vomiting, a moderately acute obstruction, or a gradually increasing interference with the passage of the intestinal contents.

Obstruction due to peritoneal adhesions.—The more acute form of obstruction is usually due to *kinking bending* or *twisting* of a short segment of bowel, whic[illegible]denly dragged upon by an adh[illegible] attached to its bo[illegible] the lumen is

increasing difficulty in securing a regular action of the bowels, progressive distension—often culminate in acute obstruction.

This form of obstruction may usually be diagnosed from the hist of previous disease in the glands or peritoneum, from the grad progress of the symptoms, and in many cases from the detection c localized swelling in the abdomen or on rectal examination.

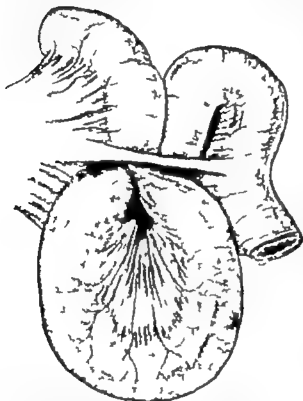


Fig 415.—Obstruction of small intestine by a band, with volvulus of the strangulated loop. (*Semi-diagrammatic*)

If the adhes cannot be separa and resection of affected segment impracticable, anastomosis sho be established tween the bo above and be the obstruction. this is not possi at the time a te porary opening m be made in bowel above obstruction, and more radical ope tion perform when the patien in a better condit to stand it. results of the operations ha been satisfacto especially in ca due to tuber losis.

STRANGULATION BY BANDS AND THROUGH ABNORMAL APERTURES

Strangulation by bands.—This is a common cause of ac obstruction. The constricting agent may be a solitary fibrous ba passing across the peritoneal cavity (Figs. 414, 415) a portion of great omentum that has formed abnormal attachments, a Meck diverticulum, or some misplaced and abnormally attached anatomi structure, such as the vermiform appendix or the Fallopian tube

1 *Solitary peritoneal bands* result from the moulding and stretch of plastic exudate between two inflamed peritoneal surfaces. Th

are therefore, most commonly found in the vicinity of the vermiform appendix (Fig. 416) and female pelvic organs, near hernial apertures or in relation with localized foci of tuberculosis either in the bowel or the mesenteric glands. Not infrequently a band forms at the site of a previous operation.

As a rule, one end of the band is attached to the mesentery and the other to the parietal peritoneum, to another part of the mesentery or to one of the viscera (Fig. 416). Occasionally one extremity becomes separated and floats free among the viscera.

Bands vary in length from a fraction of an inch to several inches, and in thickness from a mere thread to a cord as thick as the finger. As a rule they are round and cord-like but sometimes they are flattened like a ribbon.

2. *Omental bands*.—The free edge of the great omentum not infrequently forms attachments with some part that has been the seat of inflammation, such as the region of the vermiform appendix, the Fallopian tube, tuberculous mesenteric glands, or a loop of intestine which has been injured or is the seat of ulceration and in course of time the adherent portion becomes so stretched and moulded as to constitute a band. Bands formed in this way are usually broader and stronger than peritoneal bands, and the fact that one end is always attached to the transverse colon, which is movable and yielding, explains why strangulation by an omental band is generally less acute than that caused by a fibrous cord.

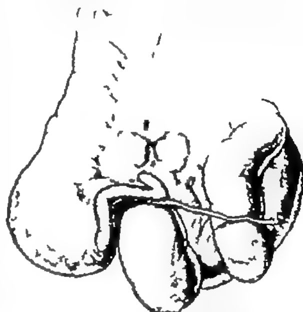


Fig. 416.—Strangulation of small intestine in a child by a cord-like band stretching between the vermiform appendix and a coil of small intestine.

(*Author's case.*)

There is often more than one omental band—a fact which must be borne in mind in cases of obstruction lest the whole of the constricting agent be not divided.

3 A *Meckel's diverticulum* may cause obstruction by acting as a band (Fig 406, p 457)

4. *Bands formed by anatomical structures abnormally attached.*—Among anatomical structures that may act as bands and so cause obstruction may be mentioned the *vermiform appendix*, which may become attached to the right ovary to the uterus, to

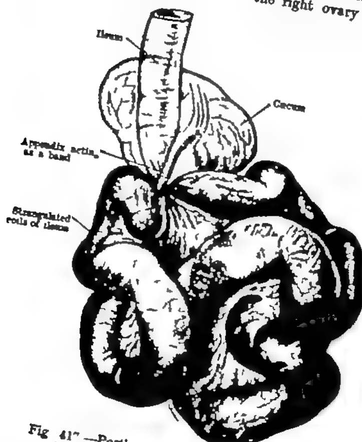


Fig 417 —Portion of small intestine strangulated by vermiform appendix acting as a band.

(*Anatomical Museum University of Edinburgh.*)

an adjacent portion of mesentery (Fig 417) or to the anterior abdominal wall

The *Fallopian tube* (Plate 94) or even an enlarged *appendix epiploica*, may act in a similar manner

The writer has operated on one case in which the *pedicle of a fibroid* of the uterus ensnared a coil of small intestine and caused obstruction, and on another in which the *pedicle of an ovarian cyst* was the cause of obstruction.



Strangulation of a loop of small intestine.

(Museum, Royal College of Surgeons, Edinburgh.)

PLATE 94.

Strangulation through abnormal apertures.—In the majority of cases of obstruction due to this cause the small intestine is prolapsed through an abnormal aperture in the mesentery of the lower ileum. Such apertures may be congenital, but are usually the result of a previous injury the mesentery having been torn by a kick or crush of the abdomen or divided in the course of an operation and not united again. In course of time the edges of the rent become smooth rounded, and unyielding and a ring or slit is formed, into which a knuckle of bowel may at any time slip Similar apertures may be met with in the great omentum, and less frequently in the mesentery of the transverse and descending colon Slits are sometimes formed by stretched adhesions resulting from peritonitis, particularly in relation to the female pelvic organs.

Clinical features.—The symptoms are usually those of the most acute forms of intestinal obstruction (p 477). Examination of the abdomen seldom reveals any localising signs, and rectal examination is likewise negative It is not uncommon, however for a considerable quantity of blood to be passed by the rectum, and in children this may suggest the possibility of intussusception. A history that the patient has previously suffered from some form of peritonitis, especially tuberculous, should suggest the presence of a band.

Treatment.—In the great majority of cases it is impossible to arrive at a positive diagnosis as to the cause of the obstruction before the abdomen is opened. The escape of blood-stained fluid on opening the peritoneal cavity is strongly suggestive of the presence of a band or of volvulus. Any loop of contracted intestine that can be found should be traced upwards until the seat of obstruction is reached. If a band is discovered, it should, if possible, be divided between forceps and the secured ends removed

When the bowel is prolapsed through an aperture it is usually necessary to divide the constricting ring before it can be released and in doing so care must be taken not to interfere unduly with the vessels of the mesentery lest the blood supply to the intestine be diminished. The opening should be closed by sutures to prevent recurrence of the protrusion. If the strangulated loop is gangrenous it should be resected , but if the patient cannot stand this at the time it must be brought to the surface opened and drained, the resection being postponed until the conditions are more favourable.

INTUSSUSCEPTION

Intussusception may be defined as the invagination of one part of the intestine into the lumen of the immediately adjoining part In the great majority of cases it is the upper segment of bowel that passes into the lower

The condition is most frequently met with in young children, and in them gives rise to one form of acute obstruction When it occurs as a primary affection in the adult, the symptoms are usually those of a gradual or intermittent obstruction, which, however may culminate in an acute and complete attack.

A typical intussusception forms a firm, rigid, sausage-like swelling,

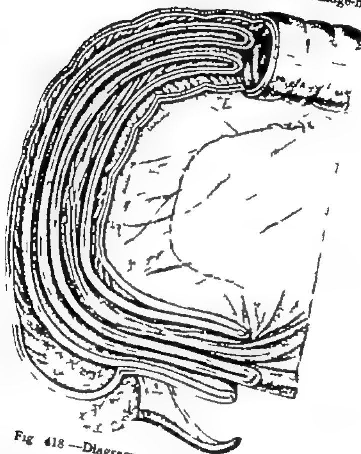


Fig 418 —Diagram of intussusception.
([illegible])

which, on account of the traction on the mesentery usually assum a semilunar or horseshoe shape It is composed of three concentricall arranged tubes of bowel which are differentiated from without inwards as follows (1) the *receiving tube* or *sheath* (2) the *returning tube* and (3) the *entering tube* The entering and returning tubes together form the *intussusceptum* and the receiving tube is the *intussuscipiens* The most advanced part of the intussusceptum, where the entering and returning layers join is known as the *apex* and is usually the

starting point of the invagination and the part at which the returning and receiving layers are continuous, and where the mesentery enters, is spoken of as the *neck*. In the space between the entering and returning layers, on the concave side of the intussusception, the mesentery is tightly packed (Fig 418)

In vertical section, the mass consists of six layers, three on each side of the central canal and on transverse section, of three concentric rings, so arranged that mucous surfaces are in contact with mucous surfaces, and serous with serous (Fig 419).

Multiple intussusceptions.—If the sheath is abnormally loose it may become folded on itself, forming a *double intussusception* (Fig 421) In rare cases it is twice folded—*triple intussusception*.

According to the segment of bowel implicated, three types of intussusception are recognised the *entero-colic*, in which the small intestine is invaginated into the colon the *colic*, in which the one part of the colon passes into the adjacent part and the *enteric*, in which one part of the small intestine is invaginated into another part.

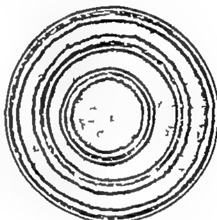


Fig. 419 —Cross-section of Intussusception.
(*Diagrammatic*)

ACUTE INTUSSUSCEPTION IN THE CHILD

As the great majority of cases of intussusception occur in children and involve the ileo-cæcal region, giving rise to a form of acute obstruction, it is convenient for clinical purposes to describe the condition in terms of this variety

Three different forms are met with (1) The *ileo-cæcal* in which the ileo-cæcal valve forms the apex of the intussusception—this is the commonest form (2) the *ileo-colic*, in which the invagination begins in the last few inches of the ileum (Fig. 422) and (3) the *cæcal* in which the inverted cæcum forms the apex.

It is not always easy however in the course of an operation to distinguish these varieties of intussusception from one another

Etiology.—The subjects of intussusception are usually lusty children in apparently perfect health, but it is generally possible to elicit a history of some recent slight disturbance of the bowels in the form of constipation or diarrhœa in which the peristaltic function of the gut has been deranged, and it is probably to irregular

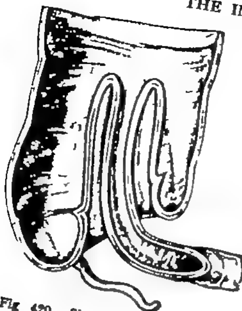


Fig 420 —Single intussusception.

muscular contraction that the commencement of the invagination is due. A portion of inflamed or swollen mucous membrane is pushed or pulled towards the lumen of the segment of gut just beyond, and acts as an irritant, setting up a reflex similar to that by which a bolus of food is passed along the bowel. The presence of a polypus or of an inverted Meckel's diverticulum or vermiform appendix, renders such an explanation of the commencement of the invagination even more easily understood (Fig. 423). The apex of the intussusception the first part to be invaginated, for all practical purposes remains constant, and, as it soon becomes congested and œdematous it is impossible for more of the entering layer to roll over and become part of the returning layer. The result is that the peristaltic efforts of the gut to force on the apex drag the sheath over the intussusceptum, so that the returning layer is gradually lengthened and the sheath creeps up the invaginated portion. An intussusception, therefore increases at the expense of the sheath.

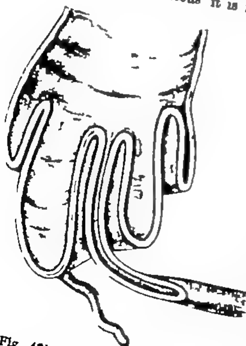


Fig 421 —Double intussusception.

The frequency with which the intussusception originates in the ileocæcal region is to be explained by the anatomical and physiological arrangements of this part of the

bowel, the last few inches of the ileum acting as a detrusor muscle to pass the intestinal contents through the ileo-colic sphincter and being studded over with numerous Peyer's patches, which are liable to become inflamed and swollen. The greater size of the lumen of the colon as compared with the ileum, and the length and

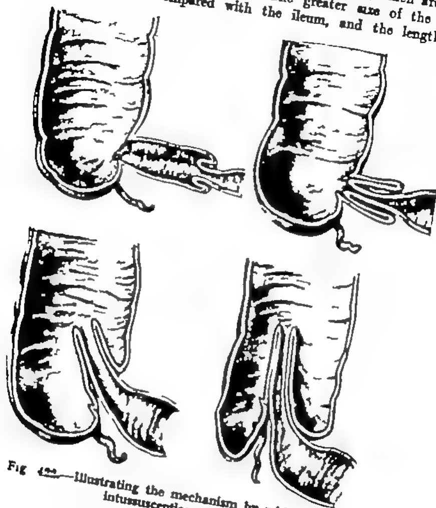


Fig [illegible].—Illustrating the mechanism by which ileo-colic intussusceptions are formed.
(Modified after D C L Fitzwilliams.)

looseness of the mesocolon of the infant also favour the folding of th receiving layer over the intussusceptum.

Morbid anatomy.—As the intussusceptum increases in length the mesentery is dragged in between the entering and returning tubes, and the tension exerted through the mesentery causes the intussusception to become curved with its concavity towards the mesenteric attachment. At the same time the whole intussusception is drawn

back towards the promontory of the sacrum where the mesentery is attached, and swings round in the direction of the hands of a watch till it may reach the left iliac fossa. In this process the mesentery is compressed, twisted, and stretched to such an extent that the vascular supply of the bowel is interfered with. At first the venous return is impeded, leading to engorgement and swelling of the invaginated bowel. As the congestion increases, blood is extravasated into the coats of the bowel, and an excess of mucus mixed with blood oozes from the mucous surfaces and is passed by the rectum.

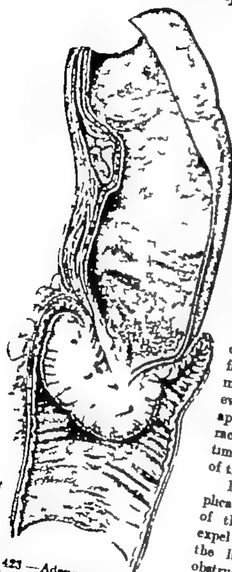


Fig 423 —Adenoma of small intestine causing intussusception. (Museum Royal College of Surgeons, Edinburgh.)

The effects of the congestion are most marked in the returning tube and towards the apex of the intussusception, which may become swollen into a knob and this, together with adhesions formed between the apposed serous surfaces, renders the intussusception irreducible. The laxity of the outer wall of the cæcum admits of its slipping farther down than the rest of the intussusceptum, so that it may even be in advance of the true apex, and after reduction a characteristic "dimple" remains for a time on the lower and outer part of the cæcal wall (Fig. 424).

In time the swelling of the implicated bowel and the contraction of the sheath in its attempts to expel the intussusceptum occlude the lumen and lead to complete obstruction.

The interference with the nutrition of the bowel is followed by bacterial invasion of the coats, which may determine gangrene or lead to peritonitis.

The gangrene affects first and chiefly the returning tube, then the entering tube, but it rarely implicates the sheath. In a certain

number of cases the whole intussusceptum has undergone necrosis and been separated in a blackish-green tubular slough, varying in length from a few inches to several feet and recovery has in very rare instances followed the expulsion of such a slough.

Clinical features.—Intussusception is the most common cause of acute obstruction in children, and the clinical picture is usually so characteristic as to leave little doubt regarding the diagnosis. Nearly 75 per cent. of the cases occur during the first year of life and about 70 per cent. are in boys. The subjects of this condition are, as a rule, fine lusty infants, and are in apparently perfect health when attacked

The illness begins with an attack of severe intestinal colic, which causes the child to scream out and draw up his knees. The face is pale and manifests severe suffering the eyes are bright and widely opened, as in fear Soon after the onset of the pain, the child usually empties the stomach by vomiting, but the vomiting is not severe or persistent and even in advanced cases it seldom becomes fæcal. The lower bowel is often emptied also the motion being a normal one This is followed by persistent tenesmus a considerable quantity of mucus tinged with blood being expelled at frequent intervals. After a time the symptoms abate, but they soon recur In the intervals the patient may be unnaturally quiet and listless but otherwise appears quite well. In most cases a general anæsthetic should be

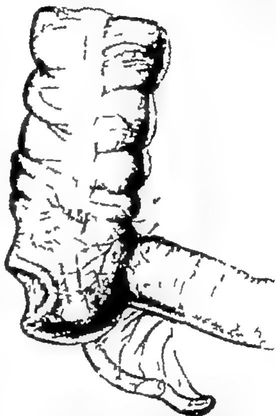


Fig 424.—To illustrate the dimple in the wall of the cæcum after reduction of an intussusception.

(After D. C. L. Fitzwilliams.)

administered to admit of a satisfactory examination of the abdomen and rectum.

When the abdomen is examined it is observed that the right iliac fossa is abnormally empty and a firm sausage-shaped swelling, curved with its concavity towards the umbilicus, can be felt in the line of the transverse or of the descending colon. The swelling may be recognized to harden and become more definite during the spasms of pain. There is seldom distension of the abdomen during the first two or three days.

The abdominal muscles are not rigid and so long as the swelling is not pressed upon the child does not resent examination of the abdomen

If the intussusception has reached the pelvic colon, as it does in about 25 per cent. of cases, it may be recognised on rectal examination as a soft, conical mass with a central slit-like depression resembling the os uteri and the examining finger may be stained with bloody mucus like red-currant jelly The sphincters are usually relaxed, but may be in a state of spasm. The intussusception seldom protrudes from the anus in acute cases.

As time goes on, the intervals between the attacks of colic are shorter the pain becomes continuous, with occasional exacerbations, and the tenesmus is constant.

The child becomes exhausted, the facial appearance alters, dark rings appear round the eyes, and the abdomen becomes distended. If infection of the peritoneum takes place, the abdomen is tender and rigid, and other signs of peritonitis develop

Differential diagnosis.—The only condition that may be mistaken for intussusception in infants is acute colitis, which is comparatively common at this age The more gradual onset of the illness and the presence of bile in the matter passed from the rectum suggest a diagnosis of colitis in intussusception the onset is sudden and the obstruction of the bowel prevents bile reaching the rectum.

Treatment.—Statistics show that every hour of delay in operating diminishes the prospect of recovery An incision is made over the most prominent part of the swelling, which is usually either in the line of the ascending colon or in the vicinity of the umbilicus. The opening should be large enough to admit of ready access to the invaginated segment of bowel, so that it may be brought to the surface with as little handling as possible In carrying out reduction of the invagination, the tumour should be straightened out as far as possible after which pressure is made on the intussusceptum by compressing the sheath just beyond the apex. On no account should the entering loop be pulled upon, as this involves considerable risk of tearing the bowel. As a rule, in early cases reduction is easily effected in this

way but the last part may be difficult to reduce on account of the apex having become œdematous, in which case, to diminish the œdema it should be gently squeezed for a few minutes through a pad of moist gauze.

After reduction has been effected, the whole length of bowel implicated should be examined for evidence of threatening gangrene or of damage to the peritoneal coat If there is any doubt as to the viability of the gut it should be brought out and an artificial anus established

To diminish the risk of recurrence a longitudinal tuck or fold may be made in the mesentery of the ileum or the mesentery may be stitched to the ascending mesocolon.

When the invagination has lasted for some considerable time reduction may be prevented by adhesions between the apposed serous surfaces of the entering and returning tubes, or by swelling of the mesentery

If it is impossible to effect complete reduction or if, when reduced the bowel is found to be gangrenous, the affected segment must be excised. By a continuous suture the sheath and the intussusceptum are united at the neck of the intussusception the sheath is then incised longitudinally and the intussusceptum removed and the operation is completed by closing the opening in the sheath, or by stitching its edges to the parietal peritoneum, and so forming an artificial anus.

If the sheath is gangrenous the whole of the segment of bowel implicated must be resected.

The mortality after all forms of resection, whether with or without the formation of an artificial anus, is high.

Chronic Intussusception in the Child

This is usually of the ileo-cæcal variety and the condition may run a slow course, associated with attacks of colicky pain, irregularity of the bowels, and the passage of blood in the stools. Visible peristalsis can sometimes be observed, particularly after a meal, and in some cases a tumour can be recognized on palpation. This tumour may change its position from time to time and sometimes it reaches the rectum and is protruded from the anus, in which case it may be mistaken for a prolapse or a polypus.

The condition is treated on the same lines as acute intussusception

Acute Intussusception in the Adult

In the adult, intussusception is a rare cause of acute obstruction, not more than 12 per cent. of all intussusceptions occurring in patients over 10 years of age.

administered to admit of a satisfactory examination of the abdomen and rectum.

When the abdomen is examined it is observed that the right iliac fossa is abnormally empty and a firm, sausage-shaped swelling, curved with its concavity towards the umbilicus, can be felt in the line of the transverse or of the descending colon. The swelling may be recognized to harden and become more definite during the spasms of pain. There is seldom distension of the abdomen during the first two or three days.

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As time goes on, the intervals between the attacks of colic are shorter the pain becomes continuous, with occasional exacerbations, and the tenesmus is constant.

The child becomes exhausted the facial appearance alters, dark rings appear round the eyes, and the abdomen becomes distended. If infection of the peritoneum takes place the abdomen is tender and rigid, and other signs of peritonitis develop

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Treatment.—Statistics show that every hour of delay in operating diminishes the prospect of recovery An incision is made over the most prominent part of the swelling, which is usually either in the line of the ascending colon or in the vicinity of the umbilicus. The opening should be large enough to admit of ready access to the invaginated segment of bowel, so that it may be brought to the surface with as little handling as possible. In carrying out reduction of the invagination, the tumour should be straightened out as far as possible, after which pressure is made on the intussusceptum by compressing the sheath just beyond the apex. On no account should the entering loop be pulled upon, as this involves considerable risk of tearing the bowel. As a rule, in early cases reduction is easily effected in this

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To diminish the risk of recurrence a longitudinal tuck or fold may be made in the mesentery of the ileum, or the mesentery may be stitched to the ascending mesocolon.

When the invagination has lasted for some considerable time reduction may be prevented by adhesions between the apposed serous surfaces of the entering and returning tubes, or by swelling of the mesentery

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The condition is treated on the same lines as acute intussusception

Acute Intussusception in the Adult

In the adult, intussusception is a rare cause of acute obstruction not more than 12 per cent of all intussusceptions occurring in patients over 10 years of age.

Generally speaking, it may be said that the etiology is the same as in children but more frequently some definite morbid condition of the bowel wall is present, such as an ulcerated polypus, a malignant tumour or a diseased condition of the mucous membrane which determines the invagination. It is a rare complication of typhoid fever

There is, therefore usually a long history of gastro-intestinal disturbance which culminates in acute obstruction. The intussusception may be of the entero-colic or of the enteric variety

The clinical features are less characteristic than in the child, and the differential diagnosis from other causes of obstruction more difficult On the whole, the symptoms are less acute than in children.

CHRONIC PRIMARY INTUSSUSCEPTION IN THE ADULT

Apart from cases in which chronic intussusception is due to tumour ulceration, or tuberculosis of the bowel wall a number of cases have been recorded in which the invagination was the primary condition leading to gradual obstruction of the bowel. Goodall of Boston has made a study of the literature of this subject, based upon 122 recorded cases.

Morbid anatomy.—The intussusception is usually of the entero-colic variety the enteric and colic forms being comparatively rare As a rule there are numerous adhesions between the different layers, which render reduction impossible, but in some cases, in spite of the fact that the condition has lasted for weeks or even months, there have been remarkably few adhesions

The lumen of the gut may be narrowed to the size of the little finger or even to that of a goose-quill, and sometimes a false opening forms which admits of the intestinal contents passing on.

Ulceration of the mucous membrane of the coils implicated is common, and the sheath frequently becomes perforated at several points, so that portions of the invaginated bowel project through it (Plate 95)

Clinical features.—The condition is usually met with in persons between 20 and 40 years of age and appears to be twice as common in men as in women.

The symptoms may come on gradually in the form of gastro-intestinal disturbance with occasional attacks during which there is a threatening of obstruction which, however passes off in some hours. This state of affairs may last over a period of months or even years, and the illness runs an obscure course

The most constant symptom is the occurrence of repeated attacks of abdominal colic coming in paroxysms, and lasting for a period which may vary from a few minutes to some hours. It is characteristic



Chronic primary intussusception in an old man.

(Author case.)

PLATE 95.

VOLVULUS

The term "volvulus" is applied to a condition in which a segment of bowel is twisted on its mesenteric axis. It is one of the most fatal of all forms of obstruction.

Volvulus of the Pelvic Colon

The pelvic colon is the segment of bowel implicated in about 75 per cent. of cases.

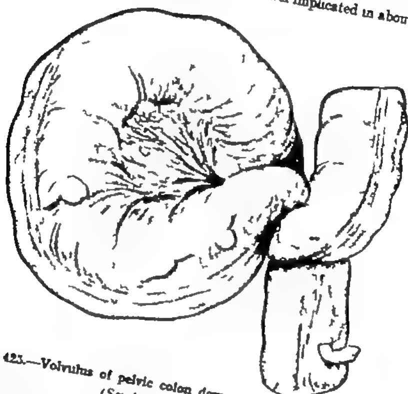


Fig 423.—Volvulus of pelvic colon downwards and forwards. (*Semi-diagrammatic*)

Etiology.—This portion of the colon which approximates in shape to the letter Ω, is rendered liable to be twisted by the fact that its mesentery is comparatively narrow in proportion to the length of the bowel, so that the two ends of the loop are approximated. The loop varies in length from about 8 in. to 2 ft. and the longer the loop, in proportion to the width of its mesentery the greater is its liability to become twisted.

The secondary changes in the mesocolon which further predispose to volvulus are—(1) *elongation* such as may result, for example, from chronic constipation—the overloaded bowel by its weight hanging down into the pelvis and dragging upon the mesentery (2) *narrowing* of the base of attachment to the sacrum resulting in closer approxi-

mation of the two ends of the Ω-loop, produced, for instance by inflammatory adhesions, by changes occurring in infected lymph glands, or as a result of chronic inflammatory or ulcerative conditions in the bowel itself (3) *fixation* of the parietal attachment as a result of thickening or adhesions due to inflammatory changes, forming an axis around which the bowel readily rotates.

The actual twisting is usually brought about by irregular peristalsis

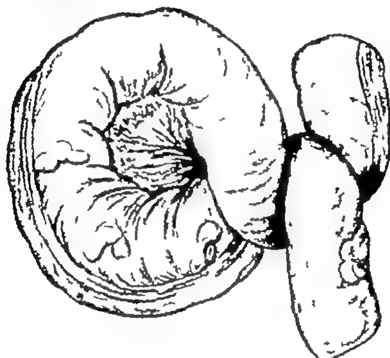


Fig 426.—Volvulus of pelvic colon backwards. (*Semi-diagrammatic*)

induced, for example, by overloading of the pelvic colon in chronic constipation, or by efforts on the part of the bowel to expel a hardened mass of fæces, or by an excessive accumulation of flatus. The mere weight of an overloaded sigmoid may cause it to fall into the pelvis and twist its base. A violent straining effort such as making a heavy lift a sudden alteration in the intra-abdominal pressure, or even a change in the attitude of the patient, may induce rotation.

As a rule, the upper part of the sigmoid rotates downwards and forwards, so that the rectum lies behind the twisted loop (Fig 425) Less commonly it passes backwards, and the rectum lies in front (Fig 426) The extent of the rotation varies from a half-twist—180°—to two or even three complete turns

Morbid anatomy—The gravity of the condition depends upon the tightness of the constriction at the base of the mesentery If the twist does not implicate the blood vessels in such a way as to occlude them, the symptoms are those of incarceration or incomplete obstruction but if the veins are occluded and the return of blood from the implicated segment is interfered with, symptoms of complete obstruction ensue The twisted loop becomes intensely congested and œdematous, and assumes a dark purple colour Hæmorrhages occur into the tissues, and serum mixed with blood escapes into the lumen of the gut and into the peritoneal cavity The fluid found on opening the abdomen is of a brownish chocolate colour—a point of some diagnostic importance.

The twisted loop rapidly becomes enormously dilated, sometimes to such an extent that it nearly fills the abdominal cavity pressing the small intestine backwards and towards the right. The diaphragm may be so pressed upon that the action of the heart and lungs is seriously impeded. The gas with which the bowel is distended is probably chiefly carbonic acid gas not absorbed from the gut owing to the occlusion of the veins. Gases of putrefaction are also present, but the rapidity with which distension occurs makes it unlikely that they are the chief cause.

The dilatation of the sigmoid may be so great that the longitudinal striæ are not recognizable, and the peritoneal covering may split and gangrene of the gut take place. Under these conditions organisms soon pass through the wall of the bowel and set up peritonitis, which speedily becomes generalized. Although patches of gangrene often form in the distended bowel perforation when it occurs, is usually above the twist.

Clinical features.—Volvulus of the pelvic colon is most frequently met with in adults in the prime of life, and is four times commoner in men than in women. There is generally a history of constipation. The symptoms usually come on suddenly and the illness rapidly assumes the characters of acute and complete obstruction. There is sharp pain, with exacerbations of a colicky character radiating along the colon to the left iliac fossa and to the lumbar region and back. In a comparatively short time, definite tenderness can be detected in the left iliac fossa, a symptom which indicates the onset of peritonitis. There is frequently severe tenesmus, but nothing is passed by the bowel. Vomiting is seldom an early or a prominent symptom, as the seat of the lesion is low down in the large intestine, but hiccup and eructation of gas are in many cases persistent. The initial shock is not so severe as in most of the other forms of acute obstruction.

The most striking and characteristic local sign is the early and

extreme degree of distension of the abdomen. Within a few hours the left side of the belly becomes prominent and yields a uniform drummy note on percussion the colon becomes so dilated that it fills the abdomen, and the other viscera are pushed aside and cannot be located by percussion. The diaphragm may be displaced up as far as the level of the third rib with the result that the circulation and the respiration are seriously interfered with Visible peristalsis is exceptional, as the bowel above the twisted loop is so pressed upon that it is incapable of contracting

If unrelieved, the condition usually proves fatal in two or three days from peritonitis due to infection through the congested loop or to perforation of the gut above the twist.

Only in rare cases is the obstruction incomplete. In these the onset is less acute and fæces and flatus may be passed in small quantities, or diarrhœa even may be present In such cases, untwisting of the bowel may occur with relief of the symptoms, but the condition is liable to recur from time to time if the pelvic colon becomes overloaded.

Treatment.—When there is reason to suspect the presence of a volvulus within a few hours of the onset of obstructive symptoms with the patient in the knee-elbow position a long rectal tube may be passed into the colon to withdraw gas and fluid. If this is not immediately successful it need not be repeated, and no time should be lost in opening the abdomen. The incision should be large enough to admit of free access to the distended coil and even of its being brought out of the abdomen. After the abdomen has been opened it may be possible with one hand inside to guide a rectal tube past the twist and so empty the distended loop of gas and fluid fæces. If successful this greatly simplifies the further manipulations if it fails, the loop must be opened and the twist undone.

If the gut is viable the opening may be closed and the loop returned to the abdomen after any adhesions that may be present have been dealt with. It is probably safer however to utilise the opening as an artificial anus till the patient has got over the immediate effects of the obstruction.

Primary resection is indicated only when the twisted loop is gangrenous, and then the divided ends of the bowel should be brought to the surface and drained a lateral anastomosis being established later

When the volvulus cannot be untwisted, an artifical anus should be established in the distended bowel above and a tube inserted into the twisted loop to drain it. If the patient survives, the affected segment of gut is subsequently resected, and the continuity of the canal re-established by end to-end suture or lateral anastomosis.

Attempts have been made to prevent recurrence of volvulus by

stitching the pelvic colon to the parietal peritoneum or to the iliac fossa, but these have not proved successful. More satisfactory results have been attained by shortening the mesentery of the pelvic colon by a series of sutures introduced so as not to interfere with the blood supply or to kink the bowel. If recurrence takes place, as it frequently does the pelvic colon should be excised.

Other Forms of Volvulus

The other portions of the intestine that may be the seat of volvulus are—(1) the *ileo-cæcal junction* and (2) the *small intestine* So long as the mesenteric arrangements of these parts are normal, volvulus cannot take place, but if the mesentery is abnormally long, or its base of attachment narrowed or rendered rigid, then volvulus may occur.

Volvulus of the Ileo-cæcal Junction—The twist may be limited to the cæcum or may also involve the ascending colon, the last part of the ileum, or both. The conditions of occurrence are the same as in volvulus of the pelvic colon, and the circumstances which determine it similar

The condition is less acute than when the pelvic colon is twisted. Vomiting is present, although not severe. The distension is not so extreme, and the distended cæcum may be recognisable in the right loin and iliac fossa, or in the left hypochondrium, as a defined resonant swelling about the size of a child's head The difficulty of undoing the twist is greater than in volvulus of the pelvic colon.

Volvulus of the small intestine is rare. There are usually adhesions, which fix the gut and form an axis of rotation.

It may affect only one loop or the entire ileum may be rotated. The rotation is usually in the direction of the hands of a watch, and amounts to one complete turn or more.

The symptoms vary in severity with the extent of bowel involved and the tightness of the strangulation. The twisted segment may form a palpable mass in the middle of the abdomen. Vomiting is always an early and severe symptom.

The **treatment** of these forms of volvulus is carried out on the same lines as that of volvulus of the pelvic colon.

OBSTRUCTION DUE TO IMPACTION OF A GALL-STONE

The term "gall-stone ileus" or "gall-stone obstruction," is applied to a rare condition in which a large gall-stone has found its way into the intestinal canal and become impacted there The gall-stone, which has formed in the gall bladder and has reached such dimensions that it cannot pass along the bile-ducts sets up irritation which leads to localised peritonitis around the gall bladder and duodenum. The adjacent parts of these viscera become adherent, and the pressure of

the gall-stone leads to the formation of a fistulous opening into the first or second part of the duodenum. It is in this way that the majority of large gall-stones enter the bowel but cases have been recorded in which the stone had so dilated the cystic and common bile-ducts that these formed a continuous cavity from which it passed directly into the gut.

In rare cases the stone ulcerates its way directly into the large intestine and is passed with the fæces without giving rise to obstructive symptoms.

If the stone is less than 1 in in diameter it usually passes safely along the intestinal canal, but if of larger dimensions it is liable to be arrested, and the larger the stone the higher up is impaction likely to take place. In the great majority of cases, impaction occurs in the lower part of the ileum. The occlusion of the bowel is due in part to the size of the stone and in part to spasm of the circular muscular fibres induced by the irritation caused by the presence of a rough foreign body If the lumen of the bowel is narrowed by cicatricial contraction or malignant disease, a comparatively small gall-stone may determine symptoms of acute obstruction if impacted in the orifice.

Clinical features.—The condition is most frequently met with in fat women between 55 and 65 years of age. There is usually the history that the patient has suffered for years from more or less constant, dull epigastric pain, with occasional exacerbations which have been attributed to indigestion. Only in a small proportion of cases is there a history of typical attacks of biliary colic associated with jaundice, doubtless because the stones that eventually cause obstruction are single and do not engage in the common bile-duct or cause obstruction of its lumen. More recently the pain has been more severe and diffuse, as a result of the localised peritonitis and ulceration associated with the formation of the fistulous tract by which the stone escapes into the bowel. At first, the stone projects into the duodenum and causes irritation, which gives rise to localized pain in the right hypochondrium and persistent vomiting. As the stone is passing along the small intestine the pain is referred to the umbilical region.

When it becomes impacted, vomiting is the most prominent symptom. It is continuous and profuse, and at first the vomited material may be tinged with blood from the fistulous track later it is bile-stained, and it soon becomes stercoraceous. The quantity of fluid vomited far exceeds that taken by the mouth.

Shock and collapse are less marked symptoms and are more delayed than in the case of most other forms of acute obstruction, presumably because the vascular and nervous mechanisms of the intestine are

not interfered with. Arrest of the passage of fæces and flatus is not a constant symptom at the beginning of the illness. As the displacement of the stone from the duodenum is often brought about by the taking of a strong purge the bowels may act several times after the onset of the pain and vomiting, and thus is apt to be misleading in diagnosis. After the stone becomes firmly impacted, however constipation is complete Tenderness and rigidity of the abdomen are not marked, and distension is usually slight and not easily recognised owing to the obesity of the patient. It is sometimes possible to palpate the stone through the parietes or from the rectum while the patient is under an anæsthetic.

The **diagnosis** is always a matter of great difficulty and is seldom made with certainty before the abdomen is opened, doubtless because the possibility of this cause for the symptoms is often overlooked. H. L. Barnard who had an extensive experience of this condition, laid great stress upon the unusual character of the grouping of the symptoms as an aid in diagnosis.

Treatment.—As in other forms of acute obstruction, the only rational treatment is to remove the stone by operation and the high mortality in this form of obstruction is chiefly due to delay in operating, although in addition the age and obesity of the patients render them unfavourable subjects for operation.

If this cause is suspected the abdomen should be opened to one or other side of the middle line below the umbilicus, and the lower part of the cavity explored. As a rule the cause of the obstruction is speedily discovered, the stone being usually impacted low down in the ileum. If not the ileo-cæcal junction should be found and the intestine traced upwards from it. When distended bowel predominates, the first presenting coil should be traced towards the right until the stone is reached. The occluded loop is then withdrawn from the wound, packed off with gauze and opened in the long axis of the gut. The bowel is opened at some distance above the seat of impaction. The stone having been removed and the distended bowel emptied, the opening is closed by a Czerny Lembert suture inserted at right angles to the long axis of the bowel In some cases it has been necessary to resect the loop of bowel implicated.

If operation is impracticable, or is refused belladonna and opium may be given to relieve the symptoms.

A **chronic form** of gall-stone obstruction has been described, in which the patient suffers from intermittent attacks of colicky pain with temporary incomplete obstruction due to blocking of different parts of the gut as the stone passes along Such attacks may occur at intervals of days or weeks, and any one of them may become acute.

ENTEROLITHS, INTESTINAL CALCULI FÆCAL CONCRETIONS AND ACCUMULATIONS

Solid masses composed of phosphates of lime and magnesia, or triple phosphates, sometimes mixed with carbonate of lime, ammonia, or soda, frequently form in the intestinal canal particularly under conditions in which there is a long-continued catarrh of the bowel. Such enteroliths are often of stony hardness, but they seldom attain

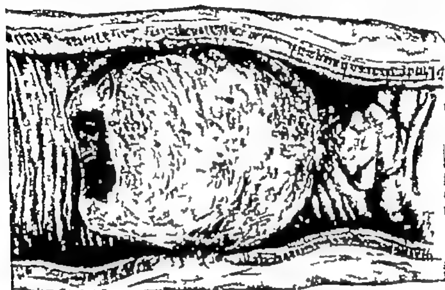


Fig 427 —Enterolith impacted in intestine.
(From a photograph lent by Dr T Macherdy)

great dimensions. A similar form composed chiefly of insoluble drugs such as magnesia salol bismuth, or chalk, which the patient has been taking medicinally over a long period, is sometimes met with. A third variety not so hard as the others is composed chiefly of the indigestible residue of certain vegetable foods notably oatmeal.

When such an adventitious object is arrested for a time in the lumen of the bowel or in a cul-de-sac in its wall, it gives rise to a *degree of chronic enteritis*, and the inflammatory products resulting from the irritation of the mucous membrane favour the adhesion of fæcal particles and lead to a gradual increase in the size of the concretion.

While these different concretions vary in composition, they have this in common, that they usually form on a nucleus of some organic substance such as a fruit-stone a mass of hairs, or a gall-stone,

It is often necessary to break down the hardened masses mechanically and this is best done under an anæsthetic The patient is placed in the lithotomy position, the anal sphincter is stretched, and with the gloved hand the scybalous masses are broken down, and then washed out. If there is evidence of stercoral ulceration, great care must be taken that the bowel be not perforated in this procedure.

When symptoms of acute obstruction are present, the abdomen must be opened and an artificial anus established. After the upper bowel has been emptied, the fæcal accumulation may be softened and removed by injections made through the artificial opening as well as by the anus.

Surgical treatment of habitual constipation.—Apart from those cases in which habitual constipation culminates in a fæcal obstruction of the bowel attempts have been made by surgical measures to relieve the patient of the discomfort and ill health induced by the chronic condition of the colon. The separation of adhesions between the colon and the parietes or adjacent viscera, which interfere mechanically with the peristaltic action of the bowel, is often followed by marked improvement. Mansell Moullin has suggested and practised ileo-colostomy with some degree of success, but this operation is not always feasible, and has not proved entirely satisfactory

Complete excision of the colon has been advocated by Arbuthnot Lane, the ileum being connected with the rectum, either by end to-end suture or by lateral anastomosis.

In a certain number of cases it has been found that habitual constipation has been due to an hypertrophied condition of the rectal valves of Houston and that removal of these thickened folds of mucous membrane by means of the knife or cautery has effected a cure of the condition.

POSTOPERATIVE OBSTRUCTION

This term is here used in relation to that form of acute obstruction which is an immediate and direct result of operation, and is mainly due to paralysis of the intestine. Obstruction due to strangulation by bands or to other mechanical effects of peritoneal adhesions resulting from a previous operation is described elsewhere (pp. 490 492).

After abdominal operations, the bowel may become distended with gas, which the patient is unable to expel, either on account of a spasm of the anal sphincters or because of pain in the abdominal wound when he strains. As the flatus accumulates, the bowel is gradually stretched, and its muscular coat loses its tone and becomes paralysed. Paralysis of the bowel with symptoms of complete obstruction sometimes follows prolonged operations in which there has been excessive

handling of the gut or forcible retraction of the edges of the wound It is most liable to ensue if a large amount of bowel has had to be withdrawn from the abdominal cavity and the exposed coils have not been kept moist and warm.

In cases of localized sepsis—for example, appendicitis with abscess formation—there is often difficulty in securing an action of the bowels for some days after the operation. This may be due to paralysis of the loops of bowel in the vicinity of the abscess, or to adjacent coils being glued together by plastic lymph to such an extent that the peristaltic waves are arrested by the adhesions Sometimes the obstruction is accounted for by the pressure of a rigid drainage-tube on the bowel.

The most common and most serious cause of postoperative obstruction is general peritonitis, which may be due to spread of the disease for which the operation was performed, or to infection introduced at the operation. Occasionally embolism or thrombosis of the mesenteric vessels causes paralytic obstruction.

Clinical features.—The most prominent symptoms are gradually increasing distension of the abdomen and a progressive rise in the pulse-rate. Sooner or later mouthfuls of brown fetid fluid regurgitate from the stomach almost continuously without retching or effort. In some cases the fluid collects in the stomach for some hours and is ejected in large quantities, the emptying of the stomach giving great relief for a time. Occasionally no vomiting occurs till just before death, when a large quantity of brown, foul smelling material often mixed with blood, is brought up The temperature usually remains persistently subnormal. Abdominal pain and colic are seldom complained of, and there is often an entire absence of muscular rigidity The extremities soon become cold blue and clammy although the rest of the body may maintain its warmth The features are drawn and pinched, but the eyes are often bright and clear and, although the patient looks extremely ill, he may express himself as feeling quite comfortable, and he usually fails to realize the gravity of his condition. It is seldom possible to distinguish between the paralytic and the mechanical forms.

Acute dilatation of the stomach or gastro-mesenteric ileus may closely simulate postoperative obstruction.

Treatment.—In the early stages of abdominal distension the introduction of a flatus tube into the colon through the rectum, or the administration of a turpentine or glycerine enema with Epsom salts, is usually sufficient to relieve the discomfort. If these measures fail, a hypodermic injection of $\frac{1}{30}$ gr of eserine combined with $\frac{1}{150}$ gr of atropine, often stimulates the peristalsis. Pituitary extract acts in the same way

It is often necessary to break down the hardened masses mechanically and this is best done under an anæsthetic. The patient is placed in the lithotomy position, the anal sphincter is stretched, and with the gloved hand the scybalous masses are broken down, and then washed out. If there is evidence of stercoral ulceration, great care must be taken that the bowel be not perforated in this procedure.

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If the abdominal wound has been packed or drained it should be dressed, and the gauze or tube removed.

Great relief often follows washing out the stomach. Purgatives must not be given by the mouth, as they only increase the amount of fluid matter in the paralysed intestine, and large enemata should be avoided, as they are liable to be retained.

If the symptoms become worse, the wound should be reopened, and if no definite cause for the obstruction be found, or if it cannot be removed, an artificial anus must be formed to drain the bowel. It may be necessary to open the intestine at several places.

EMBOLISM AND THROMBOSIS OF THE MESENTERIC BLOOD-VESSELS

The clinical picture in these conditions is one of acute intestinal obstruction of the paralytic type, and a diagnosis is seldom made before the abdomen is opened.

The pathological appearances and the clinical symptoms are much the same whether the obstruction is in the mesenteric artery or in the vein. The severity of the affection varies with the site and extent of the vascular interference, but even when only a limited area of bowel has its blood vessels interfered with the condition is a grave one.

The patient is usually a man between 30 and 60 years of age who suffers from infective endocarditis, mitral stenosis, or cirrhosis of the liver Without warning, the general symptoms of acute intestinal obstruction suddenly develop, but there is often diarrhœa the patient passing considerable quantities of blood, but getting no relief from movement of the bowels. There is likewise blood in the vomit.

If the abdomen is opened, it is found to contain a considerable quantity of dark, blood-stained fluid and the affected segment of intestine—varying from a few inches to the whole length of the small intestine and even part of the colon—is found of a dark chocolate colour firm, swollen, and œdematous. When the condition has lasted for some time the bowel shows signs of gangrene and there is more or less generalised peritonitis.

The condition usually proves fatal in a few hours and little benefit has followed excision of the affected portion of bowel.

ENTEROSPASM

The term "enterospasm has been applied to a condition in which, as a result of spasmodic contraction of the circular fibres of a limited segment of the bowel symptoms suggestive of acute intestinal obstruction develop.

Clinical features.—The condition is chiefly met with in neurotic women between 20 and 50 years of age who have suffered from chronic colitis with diarrhœa and blood-stained stools, or who have recently undergone a pelvic operation. Without obvious cause, the patient is seized with severe abdominal pain attended with vomiting, distension of the abdomen, and complete arrest of the passage of fæces and flatus. The attack may last for a few hours or for several days, and then pass off as suddenly as it began, and after the bowels have acted the patient again feels perfectly well

During the attack a firm, sausage-shaped swelling can sometimes be made out in the position of the contracted gut, which is usually the pelvic colon.

In its less severe forms, in which there are merely repeated short sharp attacks of colicky pain, with moderate flatulent distension lasting for an hour or two and then passing off completely the condition is suggestive of recurrent appendicitis, renal or biliary colic

It is characteristic of the affection that full doses of belladonna and hyoscyamus rapidly relieve the spasms, and the symptoms disappear Opium acts in the same way but should only be given for diagnostic purposes when there is reasonable certainty that no organic cause of obstruction exists.

Etiology—The true nature of these attacks has only been recognized within recent years as a result of laparotomy having been performed for the relief of what was believed to be an organic obstruction. A careful search for the cause of the obstruction has revealed only a firm contraction of a portion of the bowel—usually the pelvic colon—varying in length from one to several inches. Above the contracted segment, which is pale, firm, and rigid, the bowel is distended with gas and fæces, and below it is contracted and empty In some cases the spasm has relaxed and come on again while the bowel was actually under observation.

In view of the almost constant history of chronic colitis with blood in the stools, it is probable that the spasm is set up by some local lesion of the mucous membrane, such as an ulcer

Treatment.—It must be emphasized that enterospasm giving rise to symptoms so severe as to suggest acute obstruction is rare and that treatment directed towards relief of spasm alone is seldom justified, and is to be adopted only when the various causes of organic obstruction can be definitely excluded If any doubt remains, an exploratory laparotomy should be performed.

The use of morphia and other opiates should be avoided in view of the neurotic temperament of most of these patients, and if one full dose fails to give relief the diagnosis of enterospasm has almost certainly been wrong.

If the abdominal wound has been packed or drained, it should be dressed, and the gauze or tube removed.

Great relief often follows washing out the stomach. Purgatives must not be given by the mouth, as they only increase the amount of fluid matter in the paralysed intestine, and large enemata should be avoided as they are liable to be retained.

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It is characteristic of the affection that full doses of belladonna and hyoscyamus rapidly relieve the spasms, and the symptoms disappear Opium acts in the same way but should only be given for diagnostic purposes when there is reasonable certainty that no organic cause of obstruction exists.

Etiology—The true nature of these attacks has only been recognized within recent years as a result of laparotomy having been performed for the relief of what was believed to be an organic obstruction. A careful search for the cause of the obstruction has revealed only a firm contraction of a portion of the bowel—usually the pelvic colon—varying in length from one to several inches. Above the contracted segment, which is pale, firm, and rigid, the bowel is distended with gas and fæces, and below it is contracted and empty In some cases the spasm has relaxed and come on again while the bowel was actually under observation.

In view of the almost constant history of chronic colitis with blood in the stools, it is probable that the spasm is set up by some local lesion of the mucous membrane, such as an ulcer

Treatment.—It must be emphasized that enterospasm giving rise to symptoms so severe as to suggest acute obstruction is rare and that treatment directed towards relief of spasm alone is seldom justified, and is to be adopted only when the various causes of organic obstruction can be definitely excluded. If any doubt remains, an exploratory laparotomy should be performed.

The use of morphia and other opiates should be avoided in view of the neurotic temperament of most of these patients, and if one full dose fails to give relief the diagnosis of enterospasm has almost certainly been wrong

Belladonna, hyoscyamus, and similar drugs relieve the spasms in true enterospasm, and their use may be supplemented by hot baths Any coexisting inflammatory affection of the colon must of course be treated.

INFLAMMATORY AFFECTIONS

CHRONIC COLITIS

The term "chronic colitis" is, for convenience, applied to a condition in which the patient complains of recurring attacks of severe colicky pain, associated with the passage of an excessive amount of mucus in the stools, without there being any gross pathological lesion to account for the symptoms.

It cannot be too strongly emphasized that a diagnosis of "chronic colitis" should never be made until all the other affections of the bowel that may give rise to a similar train of symptoms have been excluded. These include malignant disease (p. 536) tuberculosis either of the hypertrophic or of the ulcerative type (p 523) fibromatosis of the colon (p 527) chronic appendicitis (p. 567) and localized peritonitis or abscess in the vicinity of the colon.

Clinical features.—The severity of the symptoms varies in different cases, and even in the same patient at different times, and the disease tends to run a protracted course.

In the less severe form, which is the form usually met with in men who show no signs of neurasthenia and are in other respects healthy the patient complains of persistent abdominal discomfort, not amounting to pain, particularly after meals. The appetite is poor and there is a tendency to constipation with flatulent distension. There are, however occasional attacks of looseness of the bowels with pain and tenesmus, the motions consisting largely of mucus. The patient loses flesh rapidly and often becomes markedly depressed or even melancholic The local symptoms may be referred to the right iliac fossa, and it is then difficult to distinguish this condition from chronic appendicitis, with which indeed it is often associated, but whether as cause or effect it is impossible to say

The more severe and typical form is most frequently met with in middle-aged women belonging to the upper classes, of a markedly neurotic temperament and in a poor state of health. It is common to find some uterine displacement or evidence of other pelvic disease in such subjects. The patient suffers from chronic dyspepsia with hyperacidity and is habitually constipated but has periodic attacks of severe colicky pain, attended with sickness and vomiting, and culminating in a spurious diarrhoea with the passage of large quantities of mucus intimately mixed with some pale faeculent matter containing less than the normal amount of bile The mucus is sometimes clear

like white of egg or boiled sago sometimes in flaky shreds, and sometimes it takes the form of fibrinous casts of the bowel, which may be several inches long If broken up into strips, these casts are apt to be mistaken by the patient for intestinal worms. There is usually a moderate amount of blood in the motions, and occasionally intestinal sand is present. Sometimes the patient loses a considerable quantity of blood—*hæmorrhagic colitis*

During an attack, tenderness can usually be located on making pressure over the colon and the bowel may be felt to contract under the fingers forming a firm, elongated, sausage-shaped swelling There is an absence of muscular rigidity On examining the pelvic colon with the sigmoidoscope the mucous membrane may be found to be inflamed or ulcerated and is covered with patches of shreddy mucus.

These acute attacks may recur every few weeks or months, but in the intervals the patient as a rule, does not regain strength, and often becomes extremely emaciated. The absorption of toxins affects the nervous system, and aggravates the neurasthenic tendencies of the patient who eventually passes into a condition of chronic invalidism.

Treatment.—Medical and dietetic treatment should always have a fair trial before recourse is had to operative measures. To relieve the acute symptoms during one of the paroxysmal attacks a hypodermic injection of morphia with atropine should be given to relax the spasm of the colon then, the patient being placed in the knee-elbow position and directed to retain the enema as long as possible about a pint of warm olive oil is slowly injected into the colon after an hour or two the colon is washed out with saline solution.

To correct the irritability of the colon the patient must be put on a carefully selected diet. According to von Noorden—and my experience agrees with his—the diet should be a full one and should consist of such things as fruit vegetables, brown bread, and a moderate amount of butcher's meat which leave a considerable indigestible residue. To prevent constipation and to render the fæces soft a liberal allowance of fatty food should be given as cream, butter or cod liver oil emulsion or petroleum preparations may be employed

The local treatment consists in injecting from 6 to 8 oz. of warm olive oil into the colon every night. This is to be retained till morning when the bowel is washed out with saline solution. The inflammation of the mucous membrane may be allayed by injections of one or other of the albuminous silver preparations, such as protargol or argyrol (½ to 1 per cent.)

Purgatives should be avoided if possible If they cannot be dispensed with entirely a small dose of castor oil should be taken

regularly every four or five days till the tendency to constipation has been overcome.

When such measures are ineffectual, operative interference is necessary. The best results have followed appendicostomy, the appendix being brought out in the right iliac fossa and used as a means of irrigating the colon. Several pints of warm saline solution are injected into the colon through the artificial opening two, three, or four times a day. As a rule, no antiseptic need be added, but benefit is sometimes derived from the silver salts. The irrigation must be kept up for several months, and the opening then allowed to close, which it usually does soon after the use of the injections is discontinued. During the treatment, the patient is able to continue his work and is seldom incommoded by the fistulous opening.

This procedure should be tried before recourse is had to right inguinal colostomy or ileo-sigmoidostomy.

Diverticula of the Colon—Diverticulitis

Acquired diverticula may be met with in any part of the colon, but they are most common in the sigmoid flexure. There they are not confined to the line of the mesenteric attachment, as they are in the small intestine, but form all over the gut. They are usually multiple, and vary in size from a tiny saccule just admitting a probe, to an elongated flask-shaped pouch resembling at first sight a Meckel's diverticulum: the majority are no bigger than a pea. They are formed by the protrusion of the mucosa between the muscular fibres, and are therefore composed of a serous covering and a mucous lining; sometimes the pouch enters an appendix epiploica and so receives a covering of fat. Concretions composed of inspissated fæcal matter, cholesterol, or calcium carbonate, tend to form in the saccules, where they set up various inflammatory changes, ranging from acute inflammation with abscess-formation and perforation peritonitis, to chronic pericolitis with the formation of a fibrosed mass that may simulate malignant disease.

The formation of these diverticula appears to be due to the effects of increased pressure within the gut by fæces and gas on a weakened musculature.

Clinical features.—The inflammatory complications of diverticula—diverticulitis—are usually met with in persons past middle life, and most frequently in men. When the inflammation is acute the signs and symptoms resemble those of appendicitis, only they are referable to the left iliac fossa. As in appendicitis, an acute attack may subside and be followed by recurrent attacks.

In the more chronic forms, excessive outgrowth of fibrous tissue leads to the formation of a tumour-like mass in the left iliac fossa

giving rise to symptoms similar to those of carcinoma. Adhes may form between such a mass and the pelvic viscera—notably bladder, the uterus, and the vagina—and lead to the developmen fistulæ

The other condit that may be simulated chronic diverticulitis fibromatosis of the sigm the hyperplastic forr tuberculosis, which is in this part of the co actinomycosis and, i female, various pelvi mours

Treatment.—' acute suppurative mai tations are treated or same lines as appendi In the chronic forms, sion of the affected ment of bowel is the course open, and al be carried out when feasible.

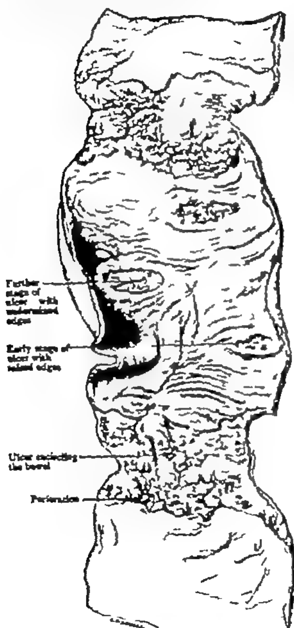


Fig. 428.—Tuberculous ulceration of the intestine.

(Museum Royal College of Surgeons, Edinburgh.)

TUBERCULOSIS THE INTESTIN

Tuberculosis affect intestine in two di ways (1) in the for acute destructive l of an ulcerative kind (2) by the slow form of localized tumou masses.

1 Tuberculou Ulceration

The ulcerative fo most frequently met in young subjects suffer from pulm phthisis or from some active tuberculous

tion. Its chief surgical interest lies in the fact that the cicatricial contraction which accompanies the healing of such ulcers leads to stenosis of the bowel.

The lower end of the ileum is the most common seat of the disease, the infection taking place from bacilli that have been swallowed in the sputum, or taken in with milk or other food, and have become implanted in the Peyer's patches and solitary glands. As the foci break down and caseate they form small, irregularly oval ulcers in the mucous membrane, the edges of which are elevated (Fig. 428) and often indurated. Such ulcers tend to spread circularly round the gut and as they heal at one part while spreading at another the contraction of the cicatricial tissue leads to stenosis of the bowel—one form of *tuberculous stricture* (Plates 96, 97) There may be several strictures scattered over a considerable length of intestine the intervening segments being dilated and sacculated in a characteristic manner

Neighbouring saccules are liable to become adherent to one another or to the parietes, and this still further interferes with the passage of the intestinal contents. The peritoneal covering of the bowel is frequently scattered over with miliary tubercles, and the associated mesenteric glands are often enlarged and caseous.

The patient is run down in health suffers from diarrhœa and symptoms associated with gradual stenosis of the bowel—recurrent attacks of abdominal pain, gradually increasing distension of the abdomen, with visible peristalsis and gurgling intestinal sounds.

The nature of the lesion can usually be recognised from the other evidence of tuberculosis or by discovering tubercle bacilli in the fæces but the diagnosis is sometimes only made after opening the abdomen.

The **treatment** is chiefly medical If operation is indicated, it consists in resecting the affected segment of gut or in short-circuiting the bowel.

The **other complications** that may follow on tuberculous ulceration of the intestine are perforations (Fig. 428) with septic peritonitis (but this is rare owing to the thickening of the peritoneal coat and the formation of adhesions outside the affected segment of bowel) the development of a cold abscess, which, on bursting, may establish a fistula with an adjacent hollow viscus or with the surface and general tuberculous peritonitis. In so far as these conditions are amenable to surgical treatment they are dealt with on the same lines as when they arise from other causes.

2 Ileo-Cæcal Tuberculosis

The hyperplastic or hypertrophic form of intestinal tuberculosis is almost always confined to the cæcum, although it may extend for



Tuberculosis of intestine, leading to multiple strictures.

(Museum Royal College of Surgeons Edinburgh.)

PLATE 96.

Contraction of the mesocolon drags the cæcum upwards so that it may lie near the liver and the ileum joins it at an obtuse angle. The glands in the mesentery may be enlarged and form a solid mass which presses upon the gut (Fig 429)

The cavity is diminished in size, and the lumen of the bowel may be narrowed down to a track no larger than a goose-quill. The ileo-cæcal valve is shrivelled up and often cannot be recognized (Plates 96 97)

The mucous membrane may be ulcerated or may present numerous villous processes projecting like polyps from its surface. These vegetations, which spring from the submucous tissue have the structure of ordinary intestinal adenomas, and they vary in size from a mere thread to a hazel nut.

Clinical features.—The condition is usually met with in patients between 20 and 40 years of age, who show slight, if any evidence of pulmonary disease. It may however occur at the extremes of life. It is insidious in its onset, and for many months may merely be associated with some loss of appetite and symptoms of indigestion, slight occasional discomfort in the right iliac fossa, and the passage of blood and mucus. As time goes on, the patient loses strength and emaciates, and he suffers from frequent attacks of griping pain coming on usually two or three hours after meals, and from alternating constipation and diarrhœa In some cases there is frequent vomiting which affords the patient relief. There may be localized distension of the bowel, with loud borborygmi and visible peristalsis, the intestine presenting a characteristic ladder pattern (Fig 411 p 484)

Sooner or later a palpable swelling can be detected in the right loin, the lower border being fairly well defined, while above it shades away in the colon. It is slightly mobile and tender and yields an impaired note on percussion.

The illness may culminate in an attack of acute obstruction. Abscesses may form and, if they rupture externally may cause persistent sinuses or a fæcal fistula Perforation into the peritoneal cavity and generalized tuberculous peritonitis are rare.

Diagnosis.—Compared with cancer with which it is most liable to be confused, the progress of the disease is slow and there is a characteristic intermission in the symptoms, which may last for one or two years before becoming urgent. In some cases tuberculosis and cancer have coexisted. The differential diagnosis from chronic lesions resulting from appendicitis is seldom difficult. It is impossible to distinguish clinically between ileo-cæcal tuberculosis and fibromatosis of the colon affecting the cæcal region.

Treatment.—The treatment consists in excising the cæcum, and establishing a lateral anastomosis on the same lines as for cancer

and the results of this operation whether performed in one or in two stages have proved satisfactory

If this is found to be impossible an anastomosis may be effected between the small intestine and the colon well beyond the limits of the disease.

ACTINOMYCOSIS [1]

The cæcum is by far the most common seat of actinomycosis in the intestine, but the pelvic colon also is sometimes attacked.

The infection takes place from the mucous membrane and spreads through the various coats to the peritoneum and thence to the abdominal wall, leading to the formation of abscesses and sinuses. In the mucous membrane lining the sinuses, or in the pus that escapes from them, the ray fungus may be found.

Before the disease infiltrates the parietes, the affected segment of bowel becomes greatly thickened and adherent to adjacent structures, the whole constituting a firm, ill-defined, diffuse mass, which simulates malignant disease or tuberculosis.

The **treatment** consists in opening up the sinuses and removing the infected tissues with the sharp spoon and scissors, but the difficulty of eradicating the whole disease renders this line of treatment unsatisfactory Equally good results have been claimed for treatment by large doses of potassium iodide or of copper sulphate. Irrigation of the sinuses with a 1 per-cent. solution of copper sulphate has proved beneficial (Bevan) The insertion of tubes containing radium for a few days may be useful.

FIBROMATOSIS OF THE COLON

Under this name may be described a condition frequently met with in the colon which in its clinical aspects and on naked-eye examination is almost indistinguishable from carcinoma or the hyperplastic form of intestinal tuberculosis.

In the majority of cases hitherto reported the nature of the condition has only been recognized after the growth had been removed in the belief that it was a malignant tumour or on post mortem examination. The microscopic appearances, however show that the mass is inflammatory in character and presents none of the signs of malignant disease.

It is highly probable that many of the cases which are recorded of malignant disease of the bowel having disappeared after colostomy or short-circuiting operations performed for obstruction were of this nature.

Morbid anatomy.—Any part of the colon may be involved, but the condition is most common in the pelvic colon and rectum.

[1] *See also* Vol I., p. 915

The affected segment of bowel, varying in length from one to several inches, is converted into a firm, rigid tube. The peritoneal coat is thick, rough and granular and may show signs of adhesive inflammation. Beneath the serous coat is a uniform layer of dense fibro-adipose tissue sometimes half an inch in thickness. The muscular coat may show some degree of atrophy or may be unaltered in appearance.

More striking changes are seen in the submucous layer which is greatly thickened by an overgrowth of dense fibrous tissue. This tends to contract, and in so doing drags upon the mucous membrane which forms a series of irregular folds with deep recesses between them these are sometimes spoken of as "false diverticula."

The mucous surface may thus assume a festooned or cauliflower like appearance, simulating that of multiple adenomas or papillomas. Ulcers form in the recesses of the thickened mucosa and burrow under the surface making long, undermined tracts with overhanging flaps of mucous membrane The ulceration may extend through all the coats of the bowel and lead to perforation. In some cases the mucous membrane is unaltered in appearance and no false diverticula are present.

The lumen of the bowel is usually considerably narrowed, sometimes to such an extent as to give rise to symptoms of obstruction.

On microscopical examination, the wall of the bowel is infiltrated with chronic inflammatory tissue and there is an overgrowth of the mucous glands with aggregations of lymphoid cells between them. The epithelial cells of the glands may show proliferation, but they do not extend beyond their basement membranes, and have none of the appearances of carcinoma.

Etiology.—*These changes resemble those met with in other* organs as a result of chronic irritative conditions, and in all probability are due to infection taking place through some lesion of the mucosa—for example, an abrasion caused by a foreign body a small ulcer or the lodgment of a fæcal concretion in an acquired diverticulum, or in one of the deeper recesses of the mucosa Cases are recorded in which the infection appeared to originate in other organs, such as the uterus and Fallopian tubes, with which the colon had formed adhesions.

Clinical features.—This condition is most frequently found in patients over 40 years of age but it occurs also in younger subjects. The history of the illness resembles that of malignant *disease of the* colon. There is generally habitual constipation, with periodic attacks of diarrhœa, usually induced by the taking of a strong purgative the motions often containing blood and mucus. The patient complains of persistent abdominal pain, and there is a progressive failure of

health. When the disease extends into the rectum, a digital examination reveals a soft condition of the mucous membrane which has been compared to thick velvet or moss, and considerable narrowing of the lumen. With the sigmoidoscope the excessive rugosity and thickening of the mucosa can be seen.

On examination, the pelvic colon is felt to stand out as a firm, sausage-shaped swelling, which is tender on pressure.

A positive diagnosis is seldom possible without an exploratory operation.

Treatment.—The only satisfactory treatment is to remove the affected segment of bowel If there are symptoms of obstruction or if the patient is not in a condition for such an operation colostomy should be performed to empty the bowel, and the major operation undertaken at a later date. When the mass is considered irremovable, short-circuiting should be performed if it is practicable. In a considerable number of cases these palliative operations have been followed by diminution or even disappearance of the swelling

ULCERATION OF THE INTESTINE

It is important to distinguish between those cases in which ulceration is an accompaniment or complication of such diseases of the bowel as tuberculosis, malignant disease and chronic obstruction from enteroliths or fæcal accumulation, and those in which it is due to some specific cause, such as typhoid, dysentery or infection with particular organisms. In the former group the symptoms due to the ulcer are superadded to and cannot be distinguished from, those of the primary lesion, the treatment of which covers the treatment of the ulcer In the latter group the ulceration itself calls for treatment, or may lead to complications which bring the disease within the province of the surgeon.

Typhoid Perforation

It has been estimated that perforation of an ulcer occurs in about 2½ to 3 per cent of cases of typhoid fever This complication usually arises during the second or third week of the fever in patients who are under treatment for a severe attack, but it may be delayed until the patient is in the convalescent stage, or it may even occur in mild and "ambulant" cases and be the first manifestation of the disease

The ulcer which perforates is usually situated in the lower end of the ileum, within 2 or 3 ft. of the ileo-cæcal junction. Occasionally more than one ulcer perforates

The opening may be no larger than a pin's head, and is only discovered when some flaky lymph is removed from the serous covering of the bowel. When sloughing of the wall of the gut has taken place

the opening may be of considerable size It is usually on the convex side of the bowel, where the blood supply is least.

Clinical features.—Perforation is most frequently met with in young adult males but it may occur at any age and in both sexes. In patients who are seriously ill with general symptoms of typhoid fever the diagnosis of perforation is often extremely difficult but if there are reasonable grounds for suspecting that the bowel has given way an exploratory incision should at once be made. Experience abundantly proves that success largely depends on the shortness of the interval between the occurrence of perforation and the operation for its closure.

The symptoms that suggest perforation are the sudden onset of acute pain referred to the umbilical region or to the right lower half of the abdomen, with tenderness on pressure, and muscular rigidity most marked in the right lower quadrant of the abdomen. There is nausea and vomiting, and other symptoms of acute infective peritonitis soon supervene.

Treatment.—The abdomen is opened in the middle line below the umbilicus, or in the right semilunar line, and if the patient's condition forbids the administration of a general anæsthetic the operation can be done under local anæsthesia The cæcum is first identified and examined, and then the lower coils of the ileum. The perforation may only be revealed by removing adherent flakes of lymph, and, when it is found, it is closed by Lembert sutures and sealed by an omental graft.

As multiple perforations are not uncommon, a thorough search should be made, and any suspicious area should be invaginated with a purse-string suture, and covered with an omental graft.

When there is a patch of gangrene on the bowel and the patient cannot tolerate immediate resection, the affected loop should be brought to the surface, and an artificial anus established.

Cases have been recorded in which a second perforation occurred after the patient had recovered from an operation, and a second laparotomy was called for

Dysenteric Ulceration

For a description of dysentery the reader is referred to works on Medicine. Suffice it here to say that in the course of the disease extensive ulceration frequently occurs in the colon, particularly in the pelvic and descending portions. The typical dysenteric ulcer begins as a small yellow or grey erosion at the opening of one of the glands of the mucosa, and gradually spreads in the submucous layer undermining the mucosa and eating into the muscular coat. The affected segment of bowel is studded over with such ulcers, which as

they spread coalesce and may eventually cover a large area The irritation causes the peritoneal coat to swell and form adhesions with surrounding structures, particularly with the omentum, which serves to prevent a generalized infection of the peritoneal cavity when perforation occurs, as it frequently does. Localized suppuration in the subperitoneal or in the extraperitoneal tissue is not uncommon. Abscess of the liver is also a frequent complication. The contraction which occurs in the healing of these extensive ulcers often leads to considerable stenosis of the bowel—*dysenteric stricture.*

Treatment.—When the disease does not yield to medical measures, surgical interference is indicated to secure rest for the colon and to admit of the direct application of remedial agents to the inflamed and ulcerated mucous membrane. This is best effected by performing cæcostomy The fluids most frequently employed for irrigation are saline solution and weak solutions of the albuminous silver salts, such as protargol or argyrol, from 4 to 8 pints being used three times a day

If it is necessary to divert the fæces from the colon entirely an artificial anus is made in the first part of the ascending colon, and through this irrigation can be carried out. The artificial anus is closed when the disease has been overcome.

When it is possible to implant the lower end of the divided ileum into the pelvic colon (ileo-sigmoidostomy) beyond the ulcerated area this operation is preferable to the formation of an artificial anus.

Ulcerative Colitis

Under this term are included certain forms of ulceration of the colon which cannot be ascribed to any specific organism or irritant although they are closely allied to dysenteric ulceration.

The ulcers which may be met with at various stages vary greatly in size some being no larger than a pea while others destroy large tracts of the mucosa. The edges are raised and irregular the base is covered with feeble granulations to which shreds of tenacious mucus adhere, and the surrounding mucous membrane is inflamed and red. The mucosa between the ulcers is œdematous and raised, so that it may assume the appearance of a series of polypi. The destructive process gradually spreads through the coats of the bowel, and may end in perforation, and set up a localized pericolitis or peritonitis. If a large artery is involved, copious hæmorrhage may result. Abscess of the liver is a rare complication of this type of ulceration—a point in which it differs from the dysenteric form.

Clinical features.—The disease is commonest in early adult life and affects the sexes equally The outstanding symptom is diarrhœa attended with abdominal pain and tenderness along the line of the colon.

The bowels move very frequently sometimes every two or three hours there is seldom tenesmus unless the rectum also is implicated. The motions are watery and contain only a small proportion of fæculent matter but a great quantity of mucus, some pus, and often blood. The dejections are very offensive

As the food passes through the bowel quickly and is imperfectly digested, the patient emaciates rapidly The disease is an intractable one, and is attended with a high mortality

By the use of the sigmoidoscope, the ulcers in the pelvic colon may be seen.

Some cases run a less acute course, the symptoms disappearing and recurring at intervals.

Treatment.—General dietetic and medicinal treatment, carried out on the same lines as for other forms of inflammation and ulceration of the colon, should be tried in the first instance. The use of a Bacillus coli vaccine has proved beneficial (Hale-White) If these measures are not speedily followed by improvement cæcostomy should be performed to enable the colon to be irrigated with saline solution or solutions of the silver salts. When the lesions are confined to the lower part of the colon, local applications may be employed with the aid of the sigmoidoscope.

Stercoral Ulcers

The pressure of a hardened mass of fæces or an enterolith on the mucous membrane may give rise to ulceration—*stercoral ulcers*—the mucosa being eroded in patches (Fig 430)

Such ulcers are most frequently met with in the rectum, the pelvic colon and the cæcum and they exude a blood-stained, muco-purulent discharge, which escapes with some fluid fæcal matter giving rise to what is often misleadingly described by the patient as diarrhœa. Absorption of toxins takes place from the eroded surfaces, causing a variable degree of auto-intoxication. The ulcerative process may spread to the muscular and serous coats, and give rise to pericolitis and localised abscess, or perforation may occur and set up peritonitis.

Peptic ulcers following gastro-enterostomy are described elsewhere (p 428)

STRICTURE, OR STENOSIS

Narrowing of the lumen of the bowel is an incidental accompaniment of nearly all morbid conditions affecting the intestine, and on this factor many of the most troublesome symptoms and some of the most serious risks ultimately depend In such diseases as carcinoma, the hypertrophic form of tuberculosis actinomycosis, and fibromatosis of the colon progressive organic stenosis is an almost constant result

but as this does not constitute the essential feature of these affections it seems unnecessary and undesirable to differentiate and describe as separate conditions malignant tuberculous, and other forms of stricture The symptoms referable to the stenosis are more properly included with the other clinical features of each disease.

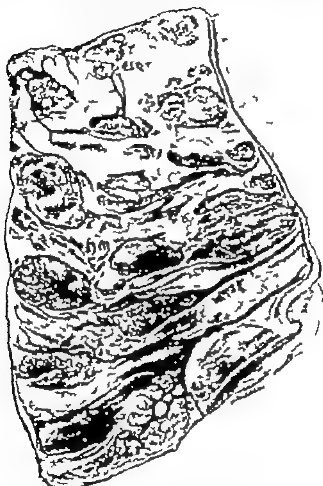


Fig 430.—Stercoral ulcers of colon.

(*Museum, Royal College of Surgeons, Edinburgh.*)

Stenosis resulting from the contraction of cicatricial tissue in or around the wall of the gut however requires special mention.

Cicatricial Stricture

The formation of cicatricial tissue in the wall of the bowel during the repair of destructive lesions is attended with a variable amount

of narrowing of the lumen, but the stenosis rarely proceeds to such an extent as to cause complete obstruction.

The interference with the passage of the intestinal contents, however is liable to be aggravated from time to time as a result of temporary congestion of the mucous membrane or spasm of the circular muscular fibres. If to this is added a kinking or torsion of the affected loop the lumen may be entirely occluded and acute symptoms suddenly supervene.

The most common cause of cicatricial stenosis is the healing of a tuberculous ulcer (p 524) Syphilitic typhoid, or dysenteric ulceration rarely gives rise to a sufficient degree of cicatricial contraction to cause symptoms of stenosis and narrowing of the bowel seldom follows the reduction of an intussusception.

The two forms that call for special mention here are those that result from direct injury of the bowel, and from the effects of a temporary *strangulation* as in hernia.

Traumatic stricture—It occasionally happens that the process of repair in a portion of bowel which has been contused or ruptured by external violence, such as a kick or a blow subsequently results in narrowing of the tube. Similarly the cicatrix produced after closing a perforation of the gut by a purse-string or Lembert suture or that resulting after resection or lateral anastomosis, may undergo such contraction as to lead to stenosis. This appears to have been more common when mechanical means, such as Murphy's button or a bone-bobbin, were employed.

The symptoms of stenosis usually ensue from one to four months after the accident, but in one case operated upon by the writer more than a year elapsed before acute obstruction followed the invagination of a number of punctures of the small intestine produced by an iron spike.

The affected segment of bowel has usually formed adhesions with the omentum, the parietal peritoneum, or adjacent coils of intestine, which favour the occurrence of kinking or bending, and so increase the liability to obstruction.

Stricture after strangulated hernia.—This is a comparatively rare sequel of strangulated hernia, and it almost always affects the small intestine.

It may follow reduction by taxis or by operation. The stricture forms at the site of the constriction groove sometimes there is narrowing at each end of the strangulated loop As a rule, it is annular and so limited as to give the appearance of a string tied round the bowel occasionally an inch or more of the bowel is stenosed. In a case of strangulated obturator hernia operated on by the writer in which the constriction groove was invaginated by a double Lembert

suture a diaphragm formed which in the course of four months had completely occluded the bowel (Fig. 431). Perforation occurred above this diaphragm. Recovery followed resection of the affected segment with lateral anastomosis.

Clinical features of cicatricial stricture.—The symptoms are those common to all forms of increasing stenosis of the

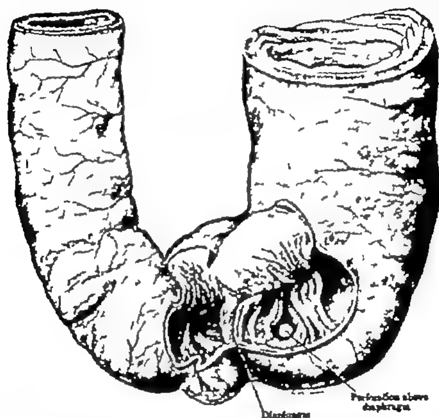


Fig 431 —Stenosis of small intestine due to formation of a diaphragm at the seat of suture after strangulated hernia.

(*Author's case*)

bowel (p 483) The history of a previous injury or operation of a strangulated hernia reduced by taxis or otherwise or of tuberculous disease of the bowel suggests this possibility

In the small intestine and upper colon, where the contents of the bowel are normally liquid, a very considerable degree of narrowing may be present before signs of obstruction manifest themselves, while in the lower colon, where the contents are solid, a moderate degree of stenosis will cause symptoms.

Marked variability in the severity of the symptoms, due to

bowels, with alternating constipation and diarrhœa, and vague abdominal pains. Sooner or later a palpable tumour is recognizable, and this rapidly increases in size.

The **treatment** is carried out on the same lines as for carcinoma, but if excision is to be successful it must be performed early

TUMOURS OF THE COLON

Innocent Tumours

The same varieties of innocent tumours are met with in the colon as in the small intestine (p 536) and they present much the same appearances and give rise to the same symptoms.

The only form that requires special mention is the **multiple adenomas**,[1] first described by Virchow in 1863. These tumours may be present in enormous numbers, some small, flat, and sessile, others pedunculated and reaching the size of a cherry or even of a walnut. They are most numerous in the pelvic and descending portions of the colon, and as a rule extend into the rectum

While originally composed of true adenomatous tissue with a covering of columnar epithelium derived from the mucous membrane, *they show a marked tendency to become malignant*, particularly when they ulcerate as they frequently do in the lower parts of the bowel where they are subjected to irritation by hard fæces.

These growths are to be clearly distinguished from the polypoid condition of the mucous membrane frequently met with in cases of ileo-cæcal tuberculous stricture of the bowel, and fibromatosis of the colon.

Clinical features.—The most characteristic feature is severe and intractable diarrhœa, frequently attended with painful tenesmus. The stools contain a great quantity of mucus, which is often mixed with blood. There is constant pain in the abdomen and tenderness on pressure along the line of the colon and the patient becomes anæmic and rapidly emaciates. The tumours may be felt on digital examination of the rectum, or they may be seen with the aid of the sigmoidoscope.

Treatment.—The only treatment that holds out any hope of complete or permanent relief is excision of the whole colon, but, as the growths frequently invade the rectum also this is not always practicable The risk of the operation in suitable cases is compensated for by the prospect of getting rid of a condition which is likely sooner or later to assume malignant characters.

No extensive operation should be undertaken to remove the growths found in the rectum until it has been determined that the colon is

[1] *See* Vol. I., p. 470.

free of them as no benefit follows this procedure. Nor does colostomy with irrigation of the colon afford such relief as to compensate for the discomfort of the artificial anus.

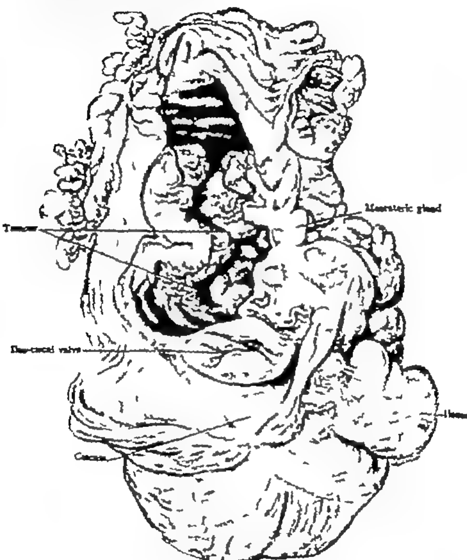


Fig. 432.—Cancer of ascending colon filling lumen of bowel.
(Museum Royal College of Surgeons, Edinburgh.)

Malignant Tumours

Carcinoma.[1]—If we exclude the rectum, it may be said that 93 per cent. of cases of carcinoma of the intestine are met with in

[1] See Vol. I., p. 680.

the colon. The tumour in the colon is nearly always the primary lesion, growths of metastatic origin being rare. The writer has met with one case in which cancer of the colon supervened in a patient whose breast he had removed for scirrhous carcinoma some years previously. Cases have been recorded in which more than one tumour was present in the bowel, probably as a result of direct infection by implantation, but cancers of different varieties may also be present in the same case.

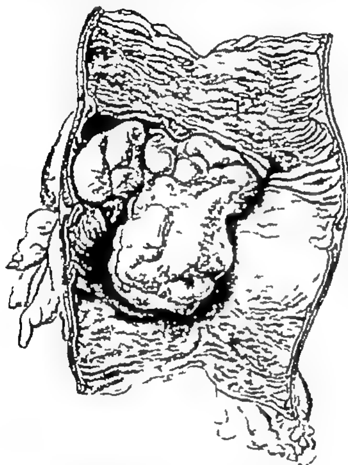


Fig 433.—Cancer of colon forming cauliflower like growth projecting into lumen of bowel.

(Museum Royal College of Surgeons Edinburgh)

As compared with cancer in other parts of the body carcinoma of the colon is, on the whole less malignant the growth of the tumour being slower the invasion of lymphatics taking place later and metastasis occurring only at a late stage in the disease. It is not on this account, however less serious, as the effect of the tumour in occluding the lumen of the gut and leading to obstruction of the bowels renders it a condition of great gravity

Morbid anatomy.—The commonest variety is the columnar epithelioma or adeno-carcinoma originating in the glands of *Lieberkühn*. The tumour may form a cauliflower-like growth which projects into the lumen of the bowel and soon ulcerates on the surface (Figs. 432, 433) or it may assume the scirrhous type, slowly encircling the

bowel and producing an annular stricture sometimes so limited in extent as to give the appearance of a string tied tightly round the bowel (Fig 434) In this form the lumen of the bowel may be



Fig 434 —Annular stricture of bowel due to scirrhous cancer

(This and the next figure are from specimens in the Museum of the Royal College of Surgeons, Edinburgh)

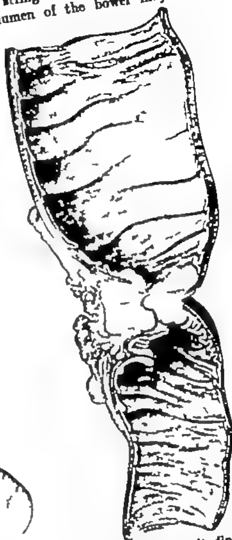


Fig 435.—Mesial longitudinal section of same specimen as Fig 434 to show occlusion of lumen by scirrhous cancer Note hypertrophy of muscular coat above stricture.

almost completely occluded before the growth ulcerates. Colloid or encephaloid degeneration may occur in either form

On mesial longitudinal section the lumen of the bowel is found contracted it may be to the size of a crow-quill by a well-defined

ridge or ring representing the oldest central portion of the growth, while above and below this the cancer extends in the mucous membrane for about an inch in each direction (Fig 435) The bowel above is distended, and its wall undergoes a moderate amount of hypertrophy The mucous membrane is in a condition of catarrh and may become ulcerated.

The disease slowly spreads to the glands of the mesocolon, and also to the retroperitoneal glands and when secondary deposits occur they almost always appear first in the liver Secondary growths are not infrequent in the omentum, mesenteries, and peritoneum, and I have met with one case in which both ovaries were also the seat of secondary deposits These are usually attended with a considerable amount of ascites. Spread by continuity to adjacent viscera, such as the stomach, the bladder the female pelvic organs, and to neighbouring coils of small intestine is not uncommon

Cicatricial contraction of the mesocolon may fix the tumour and bind it to the parietes, and this in turn may lead to kinking or bending of the bowel and cause obstruction.

Cancer of the cæcum is liable to implicate the parietes, and in the retroperitoneal tissue cellulitis and abscess formation may occur giving rise to symptoms which simulate appendicitis. The bursting of an abscess on the surface may establish a fæcal fistula.

Sites.—The pelvic colon is the most common seat of carcinoma and next in order of frequency come the cæcum and the ascending colon, the transverse colon and splenic flexure and lastly the hepatic flexure and descending colon.

Carcinoma of the pelvic colon sometimes originates in the cicatrix of a stercoral ulcer

Clinical features. *Before the onset of complete obstruction.*—The extent to which the colon may be narrowed by a malignant stricture, without giving rise to any symptoms is often remarkable, and in many cases attention is first directed to the condition by the onset of the symptoms of acute obstruction.

When the tumour manifests itself in its early stages, the symptoms are usually those of irritation of the bowel, and are common to many other conditions than cancer It may be noticed that the patient is losing strength, is depressed and listless and complains of vague abdominal discomfort, rarely amounting to pain. Loss of weight is not a prominent feature in the early stages in fact the patient may even be putting on weight There is a gradually increasing difficulty in keeping the bowels regular necessitating the frequent use of purgatives. The constipation gradually becomes more pronounced, and the medicines that previously procured a motion merely induce attacks of colicky pain and flatulent distension. Soon the patient begins

to suffer from recurrent attacks of spurious diarrhœa passing a small quantity of fæces with a good deal of mucus and some flatus. This does not give him relief, and is usually followed by a further period of constipation. The sequence of alternating constipation and diarrhœa is very characteristic of cancer of the colon and should always lead to a systematic examination of the abdomen. The stools are found to contain a small quantity of blood sometimes only detectable by the microscope, or by the guaiac or the benzidine test. There is seldom a large hæmorrhage from the bowel. No importance is to be attached to the shape of the motions, unless the cancer actually implicates the anal canal.

Vomiting is seldom a constant or prominent symptom when it occurs, it is usually in relation with the taking of food.

It is not always possible to detect a localised swelling in the abdomen as, even when of considerable size, the growth may be obscured by the thickness of the abdominal wall, or by flatulent distension. When situated in the splenic or hepatic flexure it lies under cover of the ribs. When palpable, the tumour although solid to the feel is usually resonant on percussion and it is not always tender. Frequently the swelling that is felt is due to an accumulation of fæces above a stricture, in which case it is comparatively soft and pits on pressure. In other instances it is due to the omentum or an adjacent coil of bowel having become adherent to the tumour.

On examining the rectum, it is often observed that the external sphincter is tightly contracted, the anal canal unduly short, and the rectal cavity blown up with gas, so that the finger can scarcely reach its walls, a condition which is known as "ballooning of the rectum." This is most frequently observed when the stricture is in the pelvic colon, but is not a characteristic sign of cancer. The use of the X rays after an opaque meal or enema may localise the obstruction.

When ascites is present there are usually advanced secondary deposits in the peritoneum or in the liver.

As time goes on, the patient suffers greatly from recurring attacks of colic during which visible coils of intestine may stand out and be felt to harden as a wave of peristalsis passes along them. There is increasing distension, and rumbling sounds are heard in the abdomen. The constipation becomes more marked, and, in spite of the taking of purgatives or enemata, the bowels may fail to act for days or even weeks, without acute symptoms of complete obstruction coming on.

When acute obstruction has supervened.—As a rule acute symptoms appear suddenly in a patient who has for some time shown signs of gradually increasing stenosis. In a considerable proportion of cases, however, the compensation has been so efficient that the muscular

hypertrophy has been able to overcome the obstruction, and it is only when a severe strain is suddenly thrown upon the musculature of the dilated bowel—for example by the taking of a strong purgative, or by a foreign body or a hardened fæcal mass becoming impacted in the stricture—that the compensation fails and signs of acute obstruction manifest themselves. The usual symptoms of acute obstruction are present, and there may be nothing, apart from the previous history to indicate either the cause or the seat of the obstruction. The whole colon above the stricture usually becomes greatly dilated, the dilatation supervening rapidly and being so marked that when the abdomen is opened, the longitudinal striæ cannot be recognised, and the peritoneal coat often splits with the removal of the support of the abdominal wall. The distended bowel forces its way between the layers of the mesentery which may become so much shortened as to anchor the gut. Patches of gangrene may form on the dilated bowel and perforation occur leading to peritonitis, which adds to the distension. Sometimes the cæcum alone is acutely distended, the other parts of the colon above the obstruction showing only moderate dilatation. This is probably due to the ileo-cæcal valve remaining competent and to violent anti-peristalsis forcing gas and fluid fæces back to the cæcum.

When the colon is full and bulges into the flanks, it yields a dull note on percussion, and an apparent sense of fluctuation with distinct splashing may be detected on succussion.

If peritonitis is present there is muscular rigidity and fixation, and if perforation has occurred the whole abdomen is uniformly blown up and yields a high pitched, drummy note.

Pain is not always referred to the position of the obstruction when peritonitis is present it is generally referred to the seat of infection.

Vomiting is a late symptom, and, although it may be persistent, it seldom becomes stercoraceous. Hiccup is often very intractable. The patient may linger on for some days in this condition, but ultimately succumbs to toxæmia or to exhaustion from the persistent vomiting and loss of fluid.

Cancer of the cæcum (Fig 436)—A palpable tumour is more frequently to be made out when the cancer affects the cæcum, and flatulent distension and exaggerated peristalsis of the lower coils of the ileum are often detectable. The pain frequently bears a distinct relation to the taking of food

Cancer of the transverse colon.—When a tumour is palpable, it is centrally placed and is usually freely movable. It may be of considerable size, as it is not uncommon for the omentum to be rolled up and incorporated in the growth or for the lesser omentum and even the stomach to be invaded The distension is most evident in the right flank.

Cancer of the splenic flexure.—As the growth is under cover of the ribs, it cannot be palpated. The distension affects the transverse colon, and the cæcum is sometimes greatly distended. Peristalsis

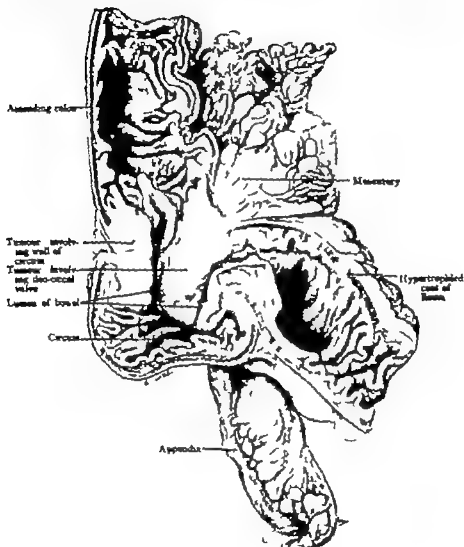


Fig. 430.—Cancer of the cæcum.
(*Author's case.*)

is usually too feeble to be recognized. Pain is often worst before defæcation.

Cancer of the descending and pelvic colon.—There is usually a palpable tumour in the left iliac fossa which may be fixed by contraction of the mesocolon but in some cases is so movable that it can be pushed

towards the middle of the abdomen or even to the right side. The tumour can sometimes be felt on bimanual examination, or it may be seen with the sigmoidoscope or its position can be recognized by X ray examination after injecting an emulsion of barium or bismuth into the bowel. The whole length of the colon is distended, the cæcum often being blown up to an enormous extent, and in rare cases the distension involves also the small intestine, producing a characteristic "ladder pattern." It is in cancer of the pelvic colon that ballooning of the rectum is most frequently present. Constipation is more marked than in cancer higher up but it alternates or may even be associated with persistent and painful tenesmus and the passage of mucus.

Complications.—In addition to complete obstruction of the bowels, which is sooner or later an almost inevitable sequel to malignant disease of the colon, various other complications may arise. The growth may, for example, form attachments with an adjacent portion of the alimentary canal, and gradually invade it, with the result that an *internal fistula* is established. So long as two adjacent coils become connected, the effects of the formation of such a fistula are not necessarily serious, but when portions of the canal widely separated from one another become fused, the short-circuiting may seriously interfere with the nutrition of the patient—for example, when the stomach is invaded by a growth of the transverse colon. It has happened that a fistulous communication between the intestine above and that beyond the cancer has temporarily relieved an obstruction. Fistulæ may also form between the colon and the bladder. The writer has observed two cases in which flatus was passed with the urine; in one this continued for about a fortnight, and then ceased, and did not recur during the fifteen months the patient survived; post mortem the opening was found occluded by cicatricial tissue apparently due to peritonitic adhesions. Similar fistulæ may also form with the urethra, the vagina, or the skin.

Intussusception is occasionally induced, and *kinking* of the bowel may occur and lead to acute obstruction.

Differential diagnosis.—In the absence of acute obstructive symptoms, the diagnosis of cancer of the colon does not present great difficulty. It is to be borne in mind that in the colon cancer occurs at an earlier age than in most other situations. Many of the patients appear to be in good general health, and show no sign of what is spoken of as a cancerous cachexia. This cachectic condition only ensues in the terminal stages of the disease when the diagnosis is no longer in doubt. The conditions that have to be borne in mind when the symptoms are referred to the region of the cæcum are ileo-cæcal tuberculosis, enterolith, and inflammatory swellings

originating in the appendix in the region of the ascending colon and hepatic flexure affections of the right kidney the liver and gall bladder the stomach and pylorus, and the omentum in the splenic flexure and descending colon affections of the left kidney and spleen in the pelvic colon, diseases of the uterine appendages, fibromatosis of the colon, and fæcal accumulation.

When symptoms of acute obstruction are present, apart from the history there is nothing characteristic of cancerous stricture and all other causes of obstruction have to be considered. It is often impossible to arrive at a diagnosis without opening the abdomen.

Treatment.—As the disease remains for a considerable time confined to the bowel and is slow to implicate the mesenteric glands, a radical operation if undertaken before there is much distension of the bowel above the stricture and before obstructive symptoms have appeared, affords a considerable prospect of permanent cure The radical operation consists in removing the affected segment, as well as several inches of the bowel above and below it, together with the lymphatic vessels draining the bowel, the glands into which these lymphatics open and the connective tissue in which they lie. The continuity of the tube is re-established either by end-to-end suture or by lateral anastomosis. With the patient in the Trendelenburg position, an incision is made which will give free access to the tumour To enable the ends to be brought together without tension, it is advisable to mobilise the segment to be dealt with, by dividing the reflection of the peritoneum on to the parietes and stripping it towards the middle line

In the majority of cases the patient is already suffering from obstructive symptoms before the question of operation is raised, and the bowel is more or less distended above the stricture. When acute obstructive symptoms are present, it is seldom possible to locate the tumour and the abdomen is best opened to the right of the middle line below the level of the umbilicus. Under these conditions, the resection should always be done by the "two-stage" method, the obstruction being relieved by opening and draining the distended bowel, and the growth removed at a later date. If it is possible at the first operation to bring the tumour out to the surface this should be done as it greatly facilitates the second stage of removal.

The second stage should be carried through as soon as the bowel has been completely emptied and the patient has sufficiently recovered from the effects of the obstruction and the primary operation. This is usually in from seven to fourteen days

If, after relieving the obstruction, it is found to be impossible to resect the growth, the patient may be saved the discomfort of a

permanent artificial anus and his life may be prolonged by entero-anastomosis, the bowel above and below the stricture being united

Sarcoma of the colon.—Sarcoma of the colon is rare, and is usually met with in the cæcum. It occurs in young subjects as a diffuse infiltration of the coats of the bowel, converting it into a rigid tube. The mucous membrane is tightly stretched over the tumour which tends to grow towards the lumen of the bowel. Obstruction is not a common manifestation of the disease. As a rule, the disease is characterized by a general weakness, loss of flesh and the development of a rapidly growing abdominal swelling

If the disease is diagnosed early the affected segment of bowel should be removed on the same lines as for carcinoma and experience has shown that the results of early operation are on the whole satisfactory

SELECTED BIBLIOGRAPHY

Barnard, H. L., *Contributions to Abdominal Surgery.* 1910.
Berry and Giuseppi, *Proc. Roy Soc. Med.*, Nov., 1908.
Caird, F M., *Scot. Med. and Surg Journ.*, 1904, xiv; *Edin. Med. Journ.*, Feb., 1921 May 1922.
Desjardins, A. V., *Ann. of Surg* 1918, lxvii.
Goodall, Harry W., *Boston Med. and Surg Journ.* April, 1910.
Hartmann, *Rev. de Chir.*, Feb., 1907
Keith, Arthur *Brit. Med. Journ.*, Feb. 5, 1910
Miles, Alexander, *Edin. Med. Journ.*, 1910 i. 1916 ii.; 1917 i.
Paterson, H. J., *Proc. Roy Soc. Med.*, June, 1909.
Pavlov, *The Work of the Digestive Glands*, 2nd Edit. 1910
Proc. Roy Soc. Med., 1909 pp. 59–99, Discussion in Med. Sec. on Ulcerative Colitis.
Telling, H. W M., and Gruner O. C., *Brit. Journ. Surg.* 1917 iv
Thomson, Alexis, *Edin. Med. Journ.*, April, 1908.
Ward, L. E. Barrington, *Brit. Journ. Surg.*, 1913 i.
Wilkie, D P D., *Edin. Med. Journ.*, 1909 ii., and Oct., 1910.

THE APPENDIX

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AND

B. C. MAYBURY, M.B., B.S., F.R.C.S.

Anatomy and physiology.—The appendix is a blind tubular diverticulum springing from the inner and posterior aspect of the cæcum at a point about 2 in. from the ileo-cæcal valve. In the fœtus and in the infant it forms the apex of the cæcum, and when this condition persists in adult life the cæcum is said to be of the fœtal type. The sacculations of the adult cæcum which displace the appendix from its apical position are of secondary formation. The appendix attains its maximum development in young adult life, and after middle age it is said slowly to atrophy. In old age it may be found represented by a mere fibrous cord.

Length.—The average length of the appendix is between 3 and 4 in., varying from ½ in., or even less, up to as much as 9 in. (R. Berry). Whilst its average diameter is about ¼ in., its lumen, unless occupied by pathological material, is very narrow. The cæcal orifice is sometimes marked by a feebly developed valve-like fold of mucous membrane (Gerlach's valve).

Position.—The appendix occupies no constant anatomical position, the variations in this respect being due to its free mobility. The situations in which it is most frequently found are (1) to the inner side of the cæcum, pointing upwards and leftwards towards the spleen (38 per cent. H. P. Hawkins); (2) pointing upwards behind the cæcum, where it often occupies and is concealed in the retrocolic fossa (26 per cent.); and (3) hanging over the pelvic brim (17 per cent.). It will be readily understood that the position in which the appendix happens to lie when it becomes acutely inflamed or perforated will determine the situation of a resulting abscess or the direction of spread of a diffuse peritonitis.

Surface marking.—McBurney's point is situated upon a line drawn from the anterior superior iliac spine to the umbilicus (spino-umbilical line) and about 2 in. internally to the iliac spine. This does not represent the situation of the appendix, but is said to be, as a rule

the point of greatest tenderness in appendicitis. Munro's point is the spot at which the spino-umbilical line crosses the outer border of the rectus muscle or linea semilunaris. According to A. Keith, the ileo-cæcal valve is the part of the intestine which most often lies directly beneath Munro's point, so that the appendicular orifice will usually be found about an inch below and to the outer side of Munro's point.

Structure.—The coats of the appendix consist of (1) a mucous membrane containing innumerable Lieberkühn's glands, and resting upon a very faintly marked muscularis mucosæ; (2) a submucous layer extremely rich in lymphoid tissue; (3) a muscular layer comprising inner circular and outer longitudinal strata corresponding with the muscular layers of the cæcum, but differing in the fact that the outer layer is disposed uniformly over the surface instead of being grouped into distinct bands; and (4) a peritoneal coat, separated from the muscle by a small amount of subserous connective tissue. The peritoneal covering is complete except just along the line of attachment of the mesentery where the vessels enter and leave the organ. The meso-appendix connects the little process to the mesentery of the termination of the ileum, springing from its inferior aspect, and is often so short as to render the appendix tortuous; it is sometimes heavily loaded with fat.

Blood vessels.—The appendix is supplied by a branch of the ileo-cæcal artery, the termination of the superior mesenteric, which passes down behind the termination of the ileum, and enters the meso-appendix, to be distributed to the organ by a series of circularly disposed branches. The veins are arranged in a similar manner and are radicles of the portal system.

Lymphatics.—The lymphatics are collected into four or five trunks which pass with the appendicular artery between the layers of the meso-appendix and travel behind the termination of the ileum to end in the ileo-cæcal glands—a group of some five or six glands situated between the layers of the mesentery of the small intestine in the upper ileo-cæcal angle (Poirier and Cunéo).

Peritoneal relations.—The clinical significance of the various positions in which the appendix may be found will be readily understood when considered in connexion with the peritoneal watersheds (p. 575). In addition to the meso-appendix, there is a second peritoneal fold, occasionally well marked, which passes from the anterior aspect of the termination of the ileum to the front of the appendicular mesentery. This is the ileo-cæcal fold (the so-called "bloodless fold") which bounds the ileo-cæcal fossa. The appendix is frequently lodged in the retrocæcal fossa, a peritoneal pouch which may be demonstrated by drawing the caput coli upwards.

Physiology.—The appendix is a vestigial structure whose func-

tions, if any are of little moment. Experience has amply proved that its removal is followed by no demonstrable alteration in the economy It has been variously credited with the provision of some secretion which prevents fæcal hardening in the cæcum with being concerned in the digestion of vegetable material with providing a fluid which stimulates peristaltic activity in the cæcum and, on account of the large quantity of lymphoid tissue which it contains, with having to do with the disposal of bacteria. W Macewen believes that the appendix possesses definite and important functions. He regards it as a sort of culture-tube from which, in response to the stimulus provided by the passage of the intestinal contents over its orifice, bacteria in a proper state of activity are from time to time discharged into the cæcum, where they assist in the disintegration of undigested food stuffs Peristaltic movements similar to those of the intestine are of normal occurrence, and can be demonstrated by X ray examination after an opaque meal. The healthy appendix fills and empties at the same time as the cæcum, and in young persons these movements may take place repeatedly while the cæcum remains full (Spriggs)

Misplacement of the appendix.—The various positions occupied by an appendix lying in the right iliac region can scarcely be termed abnormalities, as there is no "normal" position with which to compare them. The organ is, however sometimes found in situations so remote from its usual position as to constitute misplacements, and such variations are due either to (*a*) arrest in the development and descent of the cæcum, or (*b*) the presence of abnormally long and voluminous mesenteries.

(*a*) **Misplacement due to arrest of development.**—During the development of the colon the cæcum passes from the left hypochondrium across the upper part of the abdomen to the under surface of the liver and then downwards until it reaches its final adult position in the right iliac fossa. Arrest of development may cause the appendix to occupy any position upon this line of descent consequently it has been found near the spleen, in the epigastrium, beneath the liver and at various points in the right loin between the liver and the right iliac fossa.

(*b*) **Mesenteric abnormalities.**—A long mesocolon, such as that which predisposes to the production of a volvulus of the cæcum, is not infrequently responsible for abnormal positions of the appendix, especially when combined with elongation of the meso-appendix. Thus the appendix may be entirely in the pelvis, where it may be adherent to the uterus, broad ligament, or bladder it may lie entirely upon the left side of the body and be found in the left loin or left iliac fossa or it may occupy any position among the intestinal coils. A long meso-appendix, apart from any abnormality of the mesocolon, may

allow of abnormal positions being assumed by the appendix through its tip becoming adherent to other viscera and being pulled upon by them. Thus the tip of a long appendix with a long mesentery having become adherent to the pelvic colon, may be drawn upon so that it stretches across the abdomen and lies partly upon the left iliac fossa. Similarly it may become pulled upon, elongated, and displaced by any coil of small intestine to which it may have become adherent.

Just as mesenteric abnormalities permit of the appendix being found in many abnormal positions within the abdomen, so they also allow of its appearance in hernial sacs, and the organ has often been found in right-sided femoral and inguinal hernias less often in umbilical and in left-sided femoral and inguinal hernias. It may be found either alone or in company with other viscera.

In the rare instances of transposition of viscera, the caecum and appendix are found in the left iliac fossa, but with their relations to one another and to other viscera otherwise unaltered.

APPENDICITIS

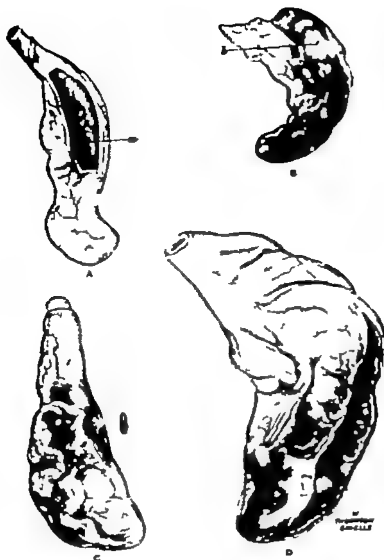
Etiology.—Appendicitis is a disease essentially dependent upon bacterial activity which may be brought about or contributed to by a number of subsidiary causes.

Bacteriology—The great majority of cases of appendicitis are caused by the B. coli (*see* Peritonitis, p. 581). Other organisms have from time to time been found in or around an inflamed appendix such as the pneumococcus (J. Eyre), the pathogenetic staphylococci (Tavel and Lanz), the Streptococcus pyogenes (Cushing) certain anaerobes (Veillon and Zuber) and B. pyocyaneus (Dudgeon and Sargent) and whilst it must be admitted that any of these organisms may be occasional causes of the disease, yet there is no doubt that the colon bacillus is by far the most frequent causal agent (Dudgeon and Sargent)

Accessory causes.—*Age* is a most important factor in the incidence of appendicitis, and its greater frequency in young adult life is probably related to the maximum development of the lymphoid tissue which is noted at that period. The disease is rare in infancy and becomes increasingly frequent between the ages of 10 and 20 when the maximum is reached from 20 to 30 the age-incidence falls but little whilst from 30 to 40 the diminution is considerable after 40 it becomes less and less frequent, until in old age it is as rare as in infancy

Sex can scarcely be cited as a cause, for there is no obvious reason, anatomical or pathological, why the disease should occur more often in one sex than in the other Yet it is a fact that all large series of cases show a distinct preponderance of males, the proportion of males to females being variously estimated as lying between 2 to 1 and 3 to 1

Heredity—There is some reason for thinking that the tendency to



A. Appendix distended by large concretion. The serous and muscular coats have been cut away to show the mucosa stretched over the concretion, and ulcerated at . (Specimen [illegible], St Thomas' Hospital Museum.)

B. Acutely inflamed appendix from boy aged 7 removed fifteen hours after the onset. At *b* the wall consists of the serous coat only; the mucosa is gangrenous. The patient recovered.

C. Perforated appendix, with concretion, from woman aged 35, removed forty-eight hours after the onset. The patient recovered.

D. Gangrenous appendix, with concretion, from fatal case. (Specimen [illegible], St Thomas' Hospital Museum.)

appendicitis runs in families. If this is so it may perhaps be ascribed to similarity of anatomical conformation favouring the disease, to similar lack of resistance to B. coli infection, or to similar habits of diet in members of the same family

Dietetic errors and *chronic constipation* undoubtedly influence the incidence of the disease. Conversely it seems probable that chronic disease of the appendix is a factor in the production of various intestinal disorders, so that the diseased appendix becomes a link in a vicious circle.

Injury has been credited with being a factor in the causation of appendicitis, since a certain number of patients give a history either of some abrupt and unaccustomed strain or of a direct abdominal injury (0·6 per cent. von Neumann) Byrom Robinson has suggested that the injury caused by the constant action of the underlying psoas muscle may be responsible for some cases.

Foreign bodies and concretions.—Pins, bristles, hairs, grains of corn fruit-seeds, and other foreign bodies have been found in inflamed appendices, but their occurrence is so uncommon as to constitute a curiosity Fæcal concretions, on the other hand, are found in about 25 per cent. of cases.

Parasites.—Threadworms are not infrequently found in appendices removed at operation. In 200 post mortem examinations of children, G F Still found the oxyuris in the appendix 25 times.

Inflammation of adjacent structures such as an ovarian cyst, may involve the appendix secondarily on the other hand, these structures may be secondarily infected from a diseased appendix. The coexistence of pelvic disease with appendicitis is well known.

Many other factors have on slender grounds for the most part, been cited as causes of appendicitis, such as exposure to cold, rheumatism, and influenza. These need but passing notice.

Appendices in abnormal situations are very prone to become the seat of disease, as for example in herniæ. In a similar manner the appendix utilized in the operation of appendicostomy is very liable to become inflamed and gangrenous. When this happens it is possible to watch the course of a case of appendicitis in the abdominal wall and uncomplicated by peritoneal involvement.

Morbid anatomy (Plate 98).—Inflammatory changes in the appendix may be of any degree, from those of a superficial catarrh up to total gangrene. In the mildest cases the mucous membrane is swollen and reddened, with but slight infiltration of the more external layers, and with little or no periappendicular effusion. An increase of secretion occurs which if the appendix be patent, escapes into the cæcum, and the inflammation subsides, leaving little trace behind. Repeated attacks of such a catarrhal inflammation leave the appendix thickened firm to the touch, and often adherent to

surrounding structures its lumen is narrowed and the lining membrane is swollen and mottled in appearance In some instances the lumen is wholly or partly obliterated (Fig. 437)

If the secretion in a catarrhal appendicitis is unable to escape freely into the cæcum several results may occur depending partly upon the completeness of the obstruction, but chiefly upon the degree of bacterial activity within the organ.



Fig 437 —An appendix, 4½ in long, with bulbous end and the greater part of it has been converted into a cord like structure.
(Specimen 99A St Thomas' Hospital Museum.)

With complete obstruction and mild bacterial activity a cyst may result, containing clear or turbid fluid, and occasionally attaining a large size (Fig 438) The fluid may prove to be sterile.

With only partial obstruction a concretion may be formed consisting of a mass of inspissated mucus and fæcal matter. These concretions frequently present, on section, a laminated appearance, as though added to from time to time by the deposition of fresh layers (Fig 439) In appearance they often resemble a cherry-stone or a date-stone and it is this resemblance which has given rise to the popular notions as to the danger of swallowing such objects. Occasionally a concretion attains a large size and resembles a gall-stone. Once a concretion has formed and is unable to escape into the cæcum, it becomes a source not only of discomfort but also of danger to its possessor inducing repeated attacks of inflammation, and threatening ulceration and perforation. If a concretion is able to escape into the cæcum or to be shifted to a different spot in the appendix, the ulcerated surface against which it lay becomes cicatrized, and a stricture results.

When the bacterial activity is great the inflammatory changes are of a more pronounced nature, and a more advanced series of changes takes place. The inflammation involves the whole thickness of the appendicular wall, and the bacteria are able to pass into the subserous tissue and finally to infect the peritoneum. The most virulent forms of peritonitis can occur from the migration of bacteria through the wall of an inflamed but unperforated appendix. Bacterial invasion of the peritoneal cavity may take place in other ways also—(1) thrombosis of the appendicular vessels followed by gangrene of the organ *en masse* (2) localized gangrene from vascular disturbance, or from pressure over a concretion, leading to rupture or perforation of the appendix



Fig 438.—An appendix which has been converted into a cyst.
(*Specimen [illegible], St Thomas Hospital Museum.*)

at the gangrenous spot (Fig 440) (3) ulceration over a concretion, or deep ulceration independent of the presence of a concretion, followed by rupture of the appendix at that spot. A foreign body sometimes, but rarely acts in the same manner as a concretion, and a sharp-pointed foreign body such as a pin may perforate the appendix mechanically (Fig 441)

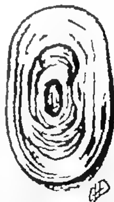


Fig 439.—Section of a large appendicular concretion, showing lamination.
(*Specimen [illegible], St. Thomas Hospital Museum.*)

When those processes which entail the passage of bacteria through the appendicular wall take place slowly and gradually the natural defensive powers of the peritoneum are called into play (*see* under Peritonitis, p 578) Around an inflamed appendix there is always a little turbid peritoneal exudate, rich in phagocytes, which is capable of dealing with the bacteria coming from the appendix, provided that an overwhelming amount of virulent material be not suddenly

discharged into the peritoneal cavity. This constitutes the first and chief line of resistance. The second protective process lies in the formation of adhesions, so that when the perforation does occur it is not into the general cavity but into a localized portion of it (Fig. 442). In this manner the effect of the bacterial invasion of the peritoneal cavity whether with or without gross perforation of the appendix, is the production of a localized abscess.

When these protective agencies, either from want of time or from lack of resistance on the part of the individual, fail to limit the infection, a diffuse, spreading peritonitis results.



Fig. 440.—A gangrenous perforated appendix, from a fatal case.

(Specimen 103, St Thomas's Hospital Museum.)

A. ACUTE FORMS OF APPENDICITIS

Clinical features.—The various morbid conditions of the appendix indicated above bear but little relation to the clinical course of the disease. A rapidly fatal diffuse peritonitis may spread from an appendix which to the naked eye appears only reddened and swollen but unperforated, or a gangrenous perforated appendix may be found in a completely localized abscess cavity. Nor is there any means of recognizing clinically the presence of constrictions, adhesions, or concretions, with the possible exception of concretions, which have sometimes been demonstrated by means of the X rays. It is not possible therefore to make clinical subdivisions to correspond with the various pathological conditions enumerated above.

Appendicitis presents itself in many different degrees of severity all of which pass by gentle gradations into one another. Nevertheless certain common types of the acute disease may be recognized, so

that the clinical course may conveniently be described under three headings —

1 Acute or subacute attacks, without perforation or gangrene, and associated with a mild and local peritonitis in the immediate neighbourhood of the appendix.

2 Acute attacks associated with ulceration, perforation, or gangrene resulting in the formation of a localized abscess around the appendix.

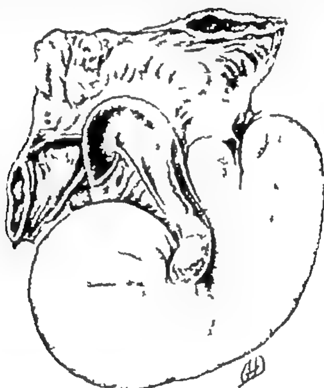


Fig. 441 —Perforation of the appendix by a pin.
(Specimen 1096a, St Thomas' Hospital Museum.)

3 Acute attacks associated with the passage of virulent bacteria from the inflamed appendix into the peritoneal cavity either with or without gross perforation or gangrene, and resulting in a diffuse, spreading peritonitis.

For the sake of brevity these may respectively be termed—(1) acute appendicitis (2) appendicitis with local abscess, and (3) appendicitis with diffuse peritonitis.

1 ACUTE APPENDICITIS

Symptoms.—The attack may be sudden and unexpected, or it may be preceded by certain symptoms which are termed prodromal.

Among these may be mentioned an indefinite feeling of malaise, indigestion, constipation, diarrhoea, and vague abdominal discomfort.

Whether preceded by prodromal symptoms or not, the attack begins with an acute pain in the abdomen, often quite sudden in its onset, which at first cannot be localised and may be referred to the epigastrium or to the umbilicus. Cope draws attention to the occasional occurrence of testicular pain, which may be left-sided, and suggests as the explanation that both the appendix and the testicle derive their nerve supply from the tenth spinal segment. The pain is rapidly followed by nausea and vomiting, and this is very soon succeeded by a rise of temperature, occasionally with an initial rigor accompanied by the usual constitutional symptoms of toxic fever The bowels may act once or twice after the onset, but then constipation usually becomes a prominent feature. Exceptionally the bowels act naturally throughout, and some of the severer cases are attended with diarrhoea.



Fig 442.—From a case of acute appendicitis of three days duration in a youth aged 17 The distal end had perforated into an omental pocket.

Examination shortly after the onset shows the abdomen to be rigid, motionless, and uniformly tender these signs soon become localised to the right iliac region and the spot of most acute tenderness is commonly found to correspond with McBurney's point. The abdomen is usually a little distended, and may be markedly so the distension may be limited to the lower half of the abdomen, and even to the right iliac region. Very soon an indefinite swelling can be felt in the right iliac fossa, which in two or three days becomes palpable as a more or less definite mass. Muscular rigidity often causes a localized swelling which may readily be mistaken for a subjacent inflammatory tumour When the appendix lies below the pelvic

brim, symptoms referable to the bladder are present, namely pain, frequency of micturition or retention of urine. Rectal pain and tenesmus may also be experienced. In these instances abdominal rigidity may be slight or absent, but examination per rectum usually reveals the presence of tenderness or a definite inflammatory mass in the right side of the pelvis. When the appendix occupies a retrocæcal position, tenderness may be found on deep palpation of the loin Brün found this sign present in 30 per cent. of cases. Meanwhile the temperature is raised, ranging from 100 to 103 or 104 although the latter is uncommon, except in children the pulse-rate is correspondingly accelerated the tongue is furred, and the appetite lost. These symptoms last from about three to ten days according to the severity of the attack. In cases of lesser severity the only symptoms complained of may be pain and nausea, while on examination a localized point of tenderness, with or without rigidity and a slight degree of pyrexia are found. The attack may subside in a few hours.

2. APPENDICITIS WITH LOCAL ABSCESS

The **symptoms** at first are the same as those described above, except that they are usually more severe, though this is not necessarily the case. The probability of abscess formation increases in proportion as the symptoms of fever and the local signs persist beyond the customary time for an ordinary attack to last. The presence of a tumour in the right iliac fossa which increases in size and definition, especially when diarrhœa replaces the initial constipation, or the existence of a tender pelvic mass together with vesical symptoms at a time when an ordinary attack would naturally be clearing up indicates the formation of an abscess. The patient prefers to lie with the right thigh drawn up full extension being painful.

Leucocytosis is regarded by some as of value in the diagnosis of abscess but, like the elevation of temperature, it is to be taken as an indication of absorption and reaction rather than of the actual presence of pus, for a large completely walled-off abscess may exist without either leucocytosis or fever

In a neglected case the skin of the abdominal wall may become œdematous and reddened, and it may even be possible to detect fluctuation but this is a sign which is rarely present, and should never be expected. If untreated the pus may make its way to the surface, but it is much more likely to rupture into the general peritoneal cavity the bowel, vagina, or bladder or it may track upwards to the subphrenic region and rupture into the pleura or respiratory passages.

3. APPENDICITIS WITH DIFFUSE PERITONITIS

The rupture or perforation of a diseased appendix, giving rise to a diffuse peritonitis, may be abrupt and unexpected.

of pus and blood per rectum, followed by a fall of temperature and an amelioration of the febrile symptoms. On the other hand, the pus may approach the surface, when the abscess will be felt as a definite rounded tumour. As localization becomes more complete, toxic absorption diminishes, so that even without evacuation of the pus the febrile symptoms in such cases subside, and the presence of a large abscess, full of the most evil-smelling pus, is not incompatible with a normal temperature and a clean tongue.

The symptoms which indicate a spreading peritonitis are an accelerating pulse-rate and a subnormal temperature, vomiting, "facies Hippocratica," and increasing abdominal distension and rigidity Hiccup is a symptom of grave import.

Treatment.—Many slight attacks of acute appendicitis subside spontaneously but, inasmuch as there is no means of distinguishing these cases at the onset the decision to postpone operation carries with it a grave responsibility With cases running a mild course, which are not seen or are not diagnosed for several days, and in which operation is strongly opposed by the patient or his friends, non-operative treatment may be adopted—for the details of which reference must be made to the textbooks of Medicine. The main points in the treatment are complete rest in bed until all pain and tenderness have disappeared, a restricted diet, a regular action of the bowels secured by enemata fomentations to the abdomen, and the avoidance of opium.

Surgical treatment of acute appendicitis.—The best time for operation is during the first twenty four hours of the attack, and the earlier the better The advantages are obvious, for not only is the mortality in this stage little greater than that of "interval" appendicectomy but the patient is saved from the risks of diffuse peritonitis and abscess-formation, the attack is cut short, and the abdominal wall is not weakened by the use of drainage-tubes.

Cases not seen or not recognised until the third, fourth, or fifth day of illness present greater difficulty The attack may then be about to subside , a small localized periappendicular abscess may have opened into the bowel or the appendix may be deeply situated amongst adhesions and surrounded by a small localized collection of pus, the disturbance of which might possibly prove to be the starting-point of a diffuse peritonitis. The difficulty of decision may be increased by the previous administration of opium this may be completely masking symptoms which, in the absence of this disturbing factor would indicate immediate operation, such as vomiting, increasing distension and rigidity and an accelerating pulse-rate. The last is of prime importance, and of all the symptoms probably the most reliable when it exceeds 100 per minute, operative interference is necessary

The operation for acute appendicitis within the first few hours of

the onset differs in no essential respect from that of an interval appendicectomy (see p 569) provided that perforation and gangrene have not taken place. When these gross changes have occurred, as they occasionally do even at so early a stage, the operation must be completed in the manner described under the next heading.

Treatment of acute appendicitis with diffuse peritonitis.—Immediate operation is the only course to be adopted, for the delay of even two or three hours may turn the scale between recovery and death. The operation consists of one essential, namely the removal of the source of infection, the appendix. The treatment of the peritoneum is of minor importance this, together with the after treatment, is described under Peritonitis (p. 585).

The methods of entering the abdominal cavity are discussed at p 569 As soon as the peritoneum is incised, a finger is gently introduced and any mass located. The affected area is packed off with gauze with as little disturbance as possible. The appendix is found by breaking down the adhesions, delivered out of the wound, and removed. The withdrawal of the whole cæcum from the peritoneal cavity is never advisable, since protective barriers are thereby broken down and the risk of spreading infection increased for the same reason coils of small intestine should not be allowed to prolapse. Occasionally in difficult cases, only the mucous membrane of the appendix need be taken away the sero-muscular coat being left *in situ* this procedure is often much easier than the removal of the whole organ, and, although a certain amount of hæmorrhage occurs, it soon ceases spontaneously Failure either to remove the outer coats of the appendix or to invaginate the stump owing to infiltration of the cæcal wall is rarely followed by any untoward result. Finally the area of the operation is sponged with dry gauze, the packing removed and the wound closed. Drainage need only be employed when there is a local abscess cavity when the vitality of a portion of the bowel wall is doubtful, or when the appendicular stump has not been invaginated. A roll of sheet rubber is preferable to a tube as its soft nature causes less damage to the bowel it should not be retained for longer than forty-eight hours If a tube is employed it should have no lateral holes, as a portion of the intestine may become strangulated in such a hole. An accident of this nature has actually been encountered (P S.)

The mere opening and draining of the abdomen in the right iliac fossa without removal of the appendix has been recommended in the belief that in desperate cases the immediate danger is thus best tided over Statistics have shown this view to be erroneous. During the years 1891 to 1903, 38 cases were so treated at St. Thomas's Hospital with a mortality of 97·3 per cent. Contrasted with this result the

operation of removal of the appendix, combined with some attempt to cleanse the peritoneum during the same period, showed a mortality of 81·2 per cent. These cases were almost all subjected to general lavage of the peritoneal cavity a procedure which is now recognized to have been wrong, and which doubtless contributed towards that exceedingly high mortality After the adoption of strictly local treatment of the peritoneum, generally by dry swabbing the death-rate fell to 30 7 per cent. in 1907 The figures given here are not those of selected cases of spreading peritonitis in an early stage, but embrace all the cases admitted to hospital with diffuse peritonitis, however desperate, which were subjected to operation. The number of cases of this class admitted to hospital of late years is fortunately too small to make recent statistical evidence of any value

Treatment of appendicitis with local abscess—An appendicular abscess must, like an abscess anywhere else, be opened as soon as a diagnosis has been arrived at. Delay involves greater risks than immediate action, the possible results being rupture of the abscess into the general peritoneal cavity into the bowel or into the bladder the formation of a subphrenic abscess retroperitoneal cellulitis and the formation of dense adhesions which may later give rise to intestinal obstruction and other troubles.

The incision is most conveniently made over the spot at which the pus is judged to be closest to the surface and should take the form of a muscle-splitting operation. For the majority either McBurney's gridiron opening, or an opening which separates the fibres of the right rectus muscle below the umbilicus, is best abscesses situated far back in the loin may be reached through a split-muscle opening similar to that of McBurney and occasionally it is advisable to open the abscess by an incision through the posterior vaginal fornix. In a neglected case the abdominal wall may be œdematous, and the skin may even be reddened over a pointing abscess, so that the pus can be reached by little more than a skin incision In others the parietal peritoneum forms part of the abscess wall, so that the pus can be readily evacuated without opening the general peritoneal cavity In most cases, however the peritoneal cavity is opened into as soon as the parietal peritoneum is incised. When this happens the general cavity must be carefully packed off with gauze strips and the abscess gently opened into with the finger As soon as the pus has ceased to flow a drain made of a roll of sheet rubber is inserted into the abscess cavity A certain amount of hæmorrhage occurs from rupture of the vessels in the granulation tissue If this does not cease, a small strip of gauze may be packed round the drain where it traverses the abdominal cavity which is thereby protected from the entrance of

infected blood. Finally the gauze strips which were used to shut off the peritoneal cavity are removed and the wound is closed. The drain should be removed on the third or fourth day

The question of immediate removal of the appendix is one that has received considerable attention, and upon which different surgeons hold different views.

According to the St. Thomas's Hospital statistics, the mortality was practically the same whether the appendix was removed at once or not.

Clearly when the appendix is readily felt in the abscess cavity and can easily be removed without much disturbance, the operation should be completed in one stage, because the illness is thereby shortened, and the patient is saved the necessity of a subsequent operation. But if the appendix is not found at once, the difficulty of the operation, the risk of causing a spreading peritonitis, and the certainty of suppuration of the relatively large abdominal wound required, render it probable that the patient's interests are best served by making no deliberate search for it, but leaving its removal to be effected at a second operation some weeks later This is the practice now generally adopted. The mortality of cases of appendicular abscess is now about 7 per cent.

That the appendix ought to be removed subsequently is now almost universally admitted. There is no evidence to support the old belief that an attack of appendicitis which ends in suppuration is curative, and that no further trouble is likely to occur All the available evidence points in the opposite direction. Recurrent attacks of acute appendicitis and recurrent abscesses are common, and even acute attacks, with diffuse and fatal peritonitis, are occasionally encountered. The St. Thomas's Hospital series contained detailed descriptions of 49 appendices removed at periods varying from two to twelve months after recovery from an abscess. In no single instance was the appendix obliterated 44·9 per cent. showed well marked constrictions 27·5 per cent. the healed scars of previous perforation, 10·3 per cent contained one or more concretions, 10·2 per cent. were cystic and contained pus, 14·2 per cent. were large and greatly thickened, 20·4 per cent. were free from adhesions, 6·1 per cent. were "catarrhal" or practically normal, and 4·1 per cent. contained unhealed ulcers. The conclusion arrived at from a critical study of the 1 075 cases in this series was, that of the subjects of appendicular abscess in whom the appendix is not removed, a minimum of 10 per cent. will suffer from further serious trouble.

There is some difference of opinion as to the time which should elapse between the drainage of an abscess and the removal of the appendix. The general practice at St. Thomas's Hospital is to perform the second operation three months after the first. It is often

very remarkable what little evidence of a former abscess is seen at the end of this period. The absence of extensive matting and gross adhesions and the rarity with which unsuspected pockets of pus are encountered render the operation an easy and safe one. The same practice applies to those cases in which a large inflammatory tumour has been allowed to subside without surgical intervention.

Appendicitis in children.—The severity of the acute disease is greater in children than in adults. All the symptoms are more pronounced and the course more rapid. Protective adhesions are less likely to form and operative treatment is therefore more frequently indicated when the patient is seen for the first time on the third or fourth day of illness. The diagnosis may be difficult owing to inability to obtain an accurate history. The disease is simulated by pneumonia, pneumococcal peritonitis, intussusception, intestinal colic, and tuberculous mesenteric adenitis.

Complications and sequelæ of acute forms of appendicitis.—Residual abscesses, commonly in the pelvis or beneath the diaphragm, empyema, pneumonia, suppuration or cellulitis and gangrene of the abdominal wall, and intestinal obstruction are described at p. 587. Other complications that may occur are the following:—

1. Ventral hernia.—Infection of the wound in the abdominal wall is the most important predisposing cause of weakness of the scar and operations performed after the first forty-eight hours of the onset of an attack are therefore particularly liable to be followed by this complication. The retention of a drainage-tube for more than a few days is another important factor and this is especially the case when the tube is brought through muscular tissue, as when McBurney's route is employed. Division of one or more nerves to the lower part of the rectus abdominis may cause weakness of that muscle and an ill-defined bulge of the abdominal wall. The occasional occurrence of an inguinal hernia after McBurney's operation is mentioned later (p. 570).

2. Pylephlebitis.—Infection of the branches of the portal vein in the liver from septic emboli is uncommon. The occurrence of jaundice, high fever and repeated rigors is of grave import, as the disease is almost invariably fatal.

3. Fæcal fistula.—The escape of gas and brown evil-smelling pus from the wound does not of necessity indicate the presence of a fæcal fistula. The commonest cause is the sloughing of some portion of the wall of the intestine, usually the cæcum, less commonly the ileum, resulting either from direct extension of the primary infection,

or from damage produced by the pressure of a hard drainage-tube which has been left *in situ* too long Occasionally the bowel is accidentally wounded during the removal of the appendix in a difficult case a fistula is very liable to occur even when the lesion has been carefully repaired. Failure to invaginate the stump of the appendix is only rarely followed by this complication.

A fæcal fistula does not often occur before the end of the first week after operation, and, although it may persist for many days, it usually closes spontaneously unless the mucous membrane of the bowel becomes adherent to the skin when an operation is always necessary to effect its closure.

Beckman states that after 500 operations for acute appendicitis, fæcal fistula occurred 24 times, an incidence of nearly 5 per cent.

4. Persistent sinus.—The presence of some foreign body such as a fæcal concretion, an unabsorbable stitch, or a portion of the appendix itself, is usually responsible. If the discharge from a sinus slowly increases in quantity the pus should be examined for the yellow granules of the streptothrix of actinomycosis.

5 Recurrent abscess —The formation of an abscess, months or years after the removal of an appendix during the acute stage, either in the abdominal wall or within the peritoneal cavity in the right iliac fossa, is not uncommon In some cases this complication results from one of the factors mentioned in the preceding paragraph In the majority however no cause can be found, and the suppuration is probably produced by the activity of organisms that have remained dormant in the cicatricial tissue since the original operation.

B. CHRONIC AND RELAPSING APPENDICITIS

The term "relapsing appendicitis" is used to describe those cases in which there are recurring attacks of an acute or chronic character Each individual attack comes into its own particular category and is more often of a subacute or chronic nature.

Chronic appendicitis includes cases in which a pathological condition of the appendix gives rise to a variety of more or less vague abdominal symptoms. "Appendicular colic" may conveniently be included in this class. By it is meant an attack of abdominal pain, more or less severe, with or without vomiting, unaccompanied by fever lasting but a few minutes or hours, and having a great tendency to recur at intervals. Such attacks are ascribed to temporary kinking and distension of the appendix, to obstruction of its lumen by stricture, or to attempts to extrude a concretion. Exactly how such attacks are caused, how far they are related to definite structural changes in the appendix, and what is their relation to appendicitis, are matters of speculation. Naturally a diagnosis of appendicular

colic should be made only with the greatest caution, and after the most careful exclusion of other causes of similar abdominal pain, such as renal colic

A large number of different symptoms are ascribed to chronic disease of the appendix Among these may be mentioned—

1 More or less persistent abdominal discomfort, increased by exertion or constipation, and not necessarily referred to the right iliac region

2 Attacks of appendicular colic

3 Chronic constipation and anæmia.

4 Chronic diarrhœa and some forms of colitis

5 Chronic "dyspepsia," and even hæmatemesis, melæna, and hunger pain.

Physical examination of the abdomen in the majority of cases is negative. Tenderness or pain, the latter being occasionally referred to the epigastric region is sometimes elicited on deep palpation in the right iliac fossa With the aid of the X rays and a barium meal Spriggs was able to demonstrate the appendix 86 times in 100 consecutive cases This author lays emphasis on the importance of the technique employed, and, in determining whether the organ is diseased *or not on the correlation of the findings* with the clinical signs, and especially on the production of tenderness over the visualized appendix. Such abnormalities as delay or defects, in filling and emptying, hyperactivity or spasms may be noted.

The **diagnosis** of chronic appendicitis ought never to be made hastily and without due consideration of the many other conditions which may give rise to similar symptoms Affections of the ovary and Fallopian tube must be eliminated by careful bimanual pelvic examination renal and ureteral calculus by the X rays and the examination of the urine, but remembering that concretions in the appendix have sometimes been demonstrated by the X rays Nephroptosis often causes considerable difficulty and the coexistence of a movable kidney and a diseased appendix may necessitate diagnosis by exploratory laparotomy followed by both appendicectomy and nephropexy Chronic disease of the appendix may give rise to many of the symptoms of gall-stones, cholecystitis, and duodenal ulcer so that in difficult cases the diagnosis has to be made by exploratory operation Patients suffering from such complaints as constipation visceroptosis atony of the colon, and neurasthenia often complain *of pain in the right lower quadrant of the abdomen*

When a palpable tumour is present in the region of the appendix and more or less vague abdominal symptoms are complained of the probability of the case being one of chronic appendicitis is great yet several other conditions can give rise to identical symptoms and signs

Among these the chief are tuberculosis, actinomycosis, and carcinoma of the cæcum, chronic cæcal intussusception, tuberculous peritonitis tuberculous mesenteric glands, and sarcoma of the ventral aspect of the ileum. The differential diagnosis of these conditions is not always possible without an abdominal exploration.

Appendicectomy.—The method of entering the abdominal cavity is a matter of great importance. Formerly the incision was made either directly through the muscles, or through the semilunar line both these methods have rightly been abandoned as being almost inevitably followed by a postoperative ventral hernia.

The method of splitting the right rectus muscle in the direction of its fibres has little to recommend it besides leading to weakness of the abdominal wall from paralysis of the inner portion of the muscle, it exposes the deep epigastric artery which in the presence of suppuration is liable to become ulcerated and give rise to secondary hæmorrhage.

There are three chief methods namely the "gridiron" incision of McBurney the temporary displacement of the rectus muscle inwards devised by W. H. Battle and the paramedian incision, in which the muscle is displaced outwards. In *McBurney's operation* the skin incision crosses the spino-umbilical line at a point 1½ in. from the antero-superior iliac spine, and is made to divide the aponeurosis of the external oblique in the same direction and for the same distance Retractors are employed to spread the skin and aponeurosis apart as widely as possible, and the fascia covering the internal oblique is divided at right angles to the first incision. The knife is then laid aside and by blunt dissection the internal oblique and transversalis abdominis muscles are split in the direction of their fibres, which at this point is as nearly as possible identical. The transversalis fascia is thus exposed, and, together with the peritoneum, is divided in a direction parallel with the skin incision. *Battle's incision* crosses the spino-umbilical line at right angles near its middle, and exposes the anterior layer of the rectus sheath, which is then divided a little internally to the skin incision and in the same direction. The outer border of the rectus muscle is now freed and drawn inwards with a retractor The posterior layer of the rectus sheath together with the underlying peritoneum, is next divided either vertically or transversely care being taken to avoid division of the motor nerves to the rectus, which are readily identified as soon as the muscle has been drawn aside. The *paramedian incision* is made an inch and a half from the middle line, opens the sheath of the rectus muscle, the inner border of which is retracted outwards, and divides the posterior layer of the rectus sheath together with the peritoneum in a vertical direction.

McBurney's incision has the advantage of being in close proximity

to the normal position of the appendix, but if more room is required it is difficult to enlarge, and in a small proportion of cases an inguinal hernia has subsequently developed from paralysis of the lower fibres of the internal oblique and transversalis muscles, the nerves to which have been damaged during the operation. It is, however the best route to employ for drainage of an appendicular abscess. Battle's incision is also placed close to the appendix, and can be extended upwards and downwards if the exigencies of any particular case require a larger abdominal opening. The nerves to the lower part of the rectus muscle, however are liable to be cut or crushed by artery forceps, and even if they are preserved while the wound is being enlarged they are very prone to be stretched or torn during the subsequent intra peritoneal manipulations. The paramedian incision is the best for removal of an appendix either in the quiet period or during the first forty-eight hours of the acute stage, if there is any doubt about the accuracy of the diagnosis, as the wound can be extended vertically in either direction without detriment and the whole of the abdominal cavity explored. Its comparative remoteness from the situation of the appendix, and the relatively large area of the general peritoneal cavity that must be traversed to reach the focus of infection make it unsuitable for cases requiring either appendicectomy after the first forty-eight hours of illness or for drainage of an abscess. Since it is never possible to be sure beforehand whether the identification and separation of the appendix will be easy or difficult, the paramedian and Battle's incisions are the more generally useful.

The removal of the appendix in the quiet period is an operation which is practically devoid of danger to life, and, if properly performed is without risk of subsequent weakness of the abdominal wall No special preparation is needed beyond the shaving and thorough cleansing of the skin at and around the site of the operation. The customary emptying of the bowels by enema on the morning of the operation is not necessary

Whichever abdominal incision is adopted, the first care of the surgeon on opening the peritoneum is to ascertain the position of the appendix. As a rule, the cæcum first comes into view and then it is an easy matter to find the appendix by following downwards the anterior muscle-band of the cæcum. Any adhesions which may be present are next carefully separated, and the appendix is brought out of the wound and isolated from the peritoneal cavity with strips of gauze. The meso-appendix having been ligatured and divided, the little process is ready for amputation. Innumerable details of technique have been devised, most of which are perfectly satisfactory Probably the two methods most frequently adopted in this country are Barker's "cuff" method and, more often Kocher's "clamp"

method. In the former the peritoneum is divided about a quarter of an inch from the base of the appendix, and turned back towards the cæcum. The rest of the appendix is ligatured and cut away and the little cuff of peritoneum is then used to cover in the stump. In the latter method a strong crushing clamp is applied to the base of the appendix close to the cæcum. This instrument divides the inner coats, which retract in either direction, leaving a flat band of crushed peritoneum which can be divided without opening the lumen of the appendix at all. This band is ligatured and divided, and the tiny stump is invaginated into the cæcal wall with a single purse-string suture. When the appendix is inflamed and swollen, the clamp method is unsatisfactory as the instrument is often found to shear the appendix across.

RARE DISEASES OF THE APPENDIX

Diseases of the appendix other than those due to pyogenetic bacteria are rare, and still more rarely do they cause symptoms independently of secondary infection. It is usually a superadded acute inflammation which directs attention to the appendix, and, as a rule, the tumour or other rare condition is discovered accidentally when the appendix is removed.

TUMOURS

Although very rare primary appendicular tumours are probably sometimes overlooked, owing to their small size and freedom from recognizable symptoms or to involvement in the necrosis of the appendix.

Innocent tumours are mere pathological curiosities. Up to 1906 Rolleston and Lawrence Jones found 42 undoubted records of primary malignant growth starting in the appendix, of which 37 were carcinoma, 3 endotheliomas, and 2 sarcoma. Raimann found 12 instances of primary carcinoma in 10,561 specimens an incidence of 0 11 per cent. The size varied from that of a pea to that of a marble, and in nearly half the cases the growth was situated in the distal third of the appendix. Metastatic growths are recorded as having been present in only 12 per cent. The average age of the patients was—for the carcinomas 30 6 years, for the endotheliomas 30·3 years, and for the sarcomas 39 years the average being thus lower than that for carcinoma in other parts of the intestinal tract by 17 years.

The commonest type is represented by a small, white, firm growth consisting of polyhedral or spheroidal cells showing an alveolar arrangement, and often exhibiting vacuolation. The commoner type of carcinoma of the appendix differs, therefore from the common type of carcinoma of the alimentary canal elsewhere in being spheroidal celled instead of columnar-celled. These spheroidal-celled growths are

also comparatively benign in their clinical character In no case was a diagnosis made before operation, and the reasons which led to the operation were either symptoms of acute, chronic, or recurrent appendicitis, symptoms referable to the female pelvic organs, or persistent fistula following abscess in the right iliac fossa.

Secondary involvement of the appendix in malignant growths of the cæcum and other parts is less uncommon. In a series of 3,770 autopsies mentioned by Kelly there was not a single example of primary tumour of the appendix, but there were 11 cases in which the organ was secondarily involved in malignant growth—10 times by carcinoma and once by sarcoma.

TUBERCULOSIS

While the appendix is not infrequently involved secondarily in tuberculous disease arising in the ileo-cæcal region, or from a tuberculous ovary or Fallopian tube, it is rarely the primary seat of the disease even then it gives rise to no symptoms by which it can be recognised clinically

In 2,000 autopsies upon patients who had died of tuberculosis, Fenwick and Dodwell found 17 cases in which the intestinal ulceration was limited to the appendix.

ACTINOMYCOSIS

Abdominal actinomycosis is most often found in the cæcal region, and in several reported cases there is no doubt that the appendix was the seat of the primary disease. The streptothrix has been demonstrated in the appendix, and more than once in company with a grain of corn. The pathology of the disease differs in no essential respect from that of actinomycosis elsewhere. (For Ileo-Cæcal Actinomycosis see Vol. I p 915.)

INTUSSUSCEPTION HERNIAS, INTESTINAL OBSTRUCTION

The appendix is almost necessarily involved in **intussusceptions** of the cæcal, ileo-cæcal, and ileo-colic varieties, and is prone to have its vascularity gravely interfered with thereby On reducing such an intussusception, it is sometimes advisable to amputate the appendix even though the little extra time required may add to the patient's danger.

Primary intussusception or inversion of the appendix itself is rare, but Battle and Corner have succeeded in collecting 17 cases from the literature. It is suggested that in the attempt to extrude a concretion the mucous membrane becomes prolapsed into the cæcum, and that this is followed by inversion of the cæcum and then of the ascending colon, so that a complicated form of intussusception is produced.

Involvement in **hernias** has been already alluded to (p. 552). According to Kelly, the appendix is present in from 1 to 2 per cent. of all hernias. A large proportion of the cases occurs in infants, when the appendix can sometimes be felt in the hernia as a rounded cord. It is commonly adherent, at any rate in the cases which are operated upon, and in congenital inguinal hernia has been found adherent to the testis. In hernial sacs the appendix has been found strangulated, inflamed, and perforated, and in this connexion an interesting point has been noted by Battle and Corner, namely, that when strangulated in a hernia the appendix is more often found alone than in company with other viscera.

Intestinal obstruction is sometimes produced by the incarceration of a coil of intestine beneath a band formed by the adherent appendix.

SELECTED BIBLIOGRAPHY

Adams, J. E., *Proc. Roy. Soc. Med.*, vol. xii., No. 9, Aug. 1919.
Battle and Corner, *Surgery of the Diseases of the Appendix*. London, 1904.
Beckman, *Amer. Journ. Med. Sci.*, Oct. 1917.
Brin, *Presse Méd.*, Jan. 16, 1910, p. 23.
Cope, Zachary, *Brit. Journ. Surg.*, 1921, No. 34, p. 215.
Cushing, Harvey, *Johns Hopkins Hosp. Repts.*, 1904, vol. viii.
Dudgeon and Sargent, *Bacteriology of Peritonitis*. London, 1905.
Fenwick and Dodwell, *Lancet*, 1894.
Hawkins, H. P., *Diseases of the Vermiform Appendix*. London, 1895.
Macewen, Sir W., *Lancet*, Oct. 8, 1904.
Poirier and Cunéo, *The Lymphatics*. London, 1903.
Rahmann, *Amer. Journ. Med. Sci.*, Aug. 1916.
Robinson, Byron, quoted by Battle and Corner.
Rolleston and Jones, Lawrence, *Med. Chir. Trans., London*, lxxxix. 125.
Sargent, Percy, *Lancet*, Sept., 1905.
Spriggs, *Lancet*, 1910, i., 91.
Still, G. F., *Brit. Med. Journ.*, April 15, 1899.
Tavel et Lanz, *Rev. de Chir.*, Paris, 1904.
Veillon et Zuber, *Arch. de Méd. Expér.*, July 1898.
Wallace and Sargent, *St. Thomas's Hosp. Repts.*, 1904.
White, Marguerite, *Lancet*, 1919, ii., 154.

THE PERITONEUM

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Anatomy and physiology.—The peritoneum is a thin, smooth, elastic membrane consisting of a layer of flattened endothelial cells resting upon a layer of subendothelial connective tissue. This membrane lines the walls of the abdominal cavity (parietal layer) and covers, with a varying degree of completeness, the abdominal and pelvic viscera (visceral layer). Its superficial area is stated to equal that of the skin. Outside the peritoneal membrane proper is the subperitoneal connective tissue which, in certain situations, is heavily loaded with fat.

The so-called peritoneal cavity is only a potential space, for its smooth opposing surfaces are everywhere in contact, being separated in health only by a minimal amount of lubricating fluid. It is only by artificial or accidental separation of these opposing surfaces that a cavity is produced.

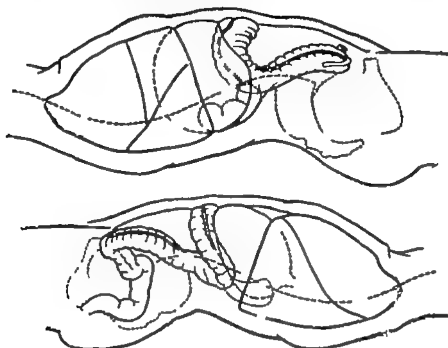
In the male the peritoneum forms a completely closed sac; in the female the interior of the Fallopian tube communicates directly with the interior of the potential peritoneal cavity through a minute orifice—the ostium abdominale.

Peritoneal compartments and pouches.—Anatomists divide the peritoneal sac into two main compartments, the greater and the lesser, communicating with one another by a narrow passage, the walls of which are normally in contact with one another. This is the foramen of Winslow; it is situated at the right side of the first lumbar vertebra close to the neck of the gall bladder. The greater sac is further subdivided, from clinical considerations, into certain areas into which fluids, when present, tend to gravitate; these very readily become shut off into more or less definite compartments by the agglutination of neighbouring areas of peritoneum.

With the body supine, the lumbar spine presents a well marked forward projection with a deep fossa on either side. A similar projection is afforded by the pelvic brim and the superjacent psoas muscles. To

these projections, which play so important a part in directing the course of fluid effusions, C. R. Box has given the name of *abdominal watersheds* (Figs. 443 and 444)

There are thus three large wells into which fluids tend to gravitate, namely the pelvic cavity and the right and left lumbar regions. But the course which effused fluid takes is further influenced by the arrangement of certain peritoneal folds and of the fixed portions of



Figs. 443 and 444.—Diagrams to show the peritoneal watersheds. (*C R Box*) (*See* text.)

the intestine. Thus the transverse mesocolon and great omentum, passing across the belly cavity mark off an upper from a lower territory which communicate with one another only in the lumbar regions. This partition is more complete on the left than the right side especially when the phrenico-colic fold of peritoneum, which passes from the left end of the transverse colon to the diaphragm below the spleen is well marked. A similar fold is sometimes present on the right side." (C R. Box.)

Above this transverse mesocolic shelf, and on the right slope of the vertebral watershed lie the pylorus, the commencement of the duodenum, the gall bladder and the right lobe of the liver in a similar position on the left side lie the stomach and spleen Effusions resulting from the perforation or inflammation of these structures will

consequently be directed, in the one case towards the right kidney and in the other towards the spleen.

Near the summit of the pelvic ridge on the right side the appendix often lies, so that a purulent effusion resulting from a diseased appendix, if it does not gravitate towards the pelvic cavity is directed upwards alongside the colon towards the right renal or subhepatic pouch. From the arrangement both of the watersheds and of the peritoneal folds, together with the anatomical disposition of the viscera which are *most frequently the source of intraperitoneal effusion*, namely the appendix, pylorus, duodenum, and bile passages, it will be seen that the right renal pouch is a region of great clinical importance. The boundaries of this pouch are above and in front, the right lobe of the liver and its ligaments below the hepatic flexure of the colon and its attachment to the posterior abdominal wall internally the peritoneum covering the descending duodenum and the lumbar spine, and stretching forwards to the foramen of Winslow externally the parietal peritoneum of the lumbar region."

The subphrenic region is also of special importance. A subphrenic abscess on the left side lies between the spleen, stomach and left lobe of the liver on the one hand and the diaphragm on the other, being separated by the diaphragm from the lower border of the lung, the pleural cavity, and the chest wall below it is limited by the phrenicocolic fold, and to the right by the falciform ligament. Similarly a right sided subphrenic abscess, lying between the right dome of the diaphragm and the liver, may be limited leftwards by the falciform ligament.

There are, in addition, certain smaller pouches which may become the seat of internal hernias, the chief of which are the paraduodenal, superior duodenal, and inferior duodenal fossæ at the left side of the 2nd lumbar vertebræ the retrocolic, ileo-cæcal and ileo-colic fossæ in the right iliac fossa and the fossa intersigmoidea close to the left sacro-iliac joint, marking the position at which the ureter crosses the external iliac artery None of these fossæ is of constant occurrence.

Lymphatics.—There is no direct communication between the peritoneal cavity and the lymphatic system, though fluids and solid particles are readily removed from the peritoneal cavity into the lymphatics. There are no "stomata" between the endothelial cells, nor over the greater part of the peritoneal membrane, are there any subendothelial lymphatic spaces. The diaphragmatic peritoneum, however presents a vast number of pits or wells, penetrating between the tendon bundles, which are microscopic diverticula of the peritoneum, and, like it, are lined in their whole extent by endothelial cells.

The peritoneal cavity is very intimately related with the subpleural diaphragmatic lymphatics, which present, according to MacCallum,

a network of branching lymphatic trunks, whose efferent vessels pass to the mediastinal and abdominal lymphatic glands. From these lymphatic vessels diverticula or pouches pass downwards through the muscular and tendinous tissue of the diaphragm, where they come into the most intimate relation with the peritoneum, being *only* separated from it by a delicate basement membrane.

Nerves.—Ramström has shown by dissection the ramifications of the lower intercostal nerves in the serous covering of the abdominal wall. While the parietal peritoneum is said to be sensitive the visceral portion is devoid of sensation both in health and in disease (Cushing and Lennander) The nerves are derived from the same source whence arises the cutaneous and muscular supply of the abdominal wall, namely the last seven thoracic trunks this fact accounts for the reflex muscular rigidity and the superficial tenderness in peritonitis.

Functions of the peritoneum—In health the peritoneum serves to permit the intestinal and other intra-abdominal movements to take place painlessly and with a minimal amount of friction. Its various folds attach the viscera to one another and to the parietes, and also serve to carry the blood vessels and other structures from the abdominal wall to the viscera

The great omentum has special functions. In addition to that of protection, fat storage and the part which, in injury and disease it is able to play in sealing an accidental opening in the bowel or in the abdominal wall, it takes a special share in the disposal of bacteria and other solid substances which may find their way into the peritoneal cavity (H. E. Durham Dudgeon and Ross)

The absorptive powers of the peritoneum are very great, and both fluids and solid particles such as bacteria are removed from the peritoneal cavity with great readiness and rapidity The fluids are mainly taken up by the lymphatics, but may also when under pressure, pass directly into the blood vessels the solid particles are removed by the lymphatics alone, provided that the membrane is intact. This lymphatic absorption occurs only over the diaphragm and omentum, and the removal of solid particles takes place chiefly by phagocytosis the particles being carried first into the pits described above, and thence into the subperitoneal lymphatic vessels and spaces (Muscatello)

The experiments of Buxton and Torrey and others have shown that inert particles and bacteria also find their way into the lymphatics without the aid of phagocytosis and Muscatello thinks that the passage of the phagocytes leaves minute apertures through which particles can afterwards be drawn by the suction action of the diaphragm and its lymphatic currents.

Absorption from the peritoneal cavity is normally aided by the pressure of the continual respiratory movements of the abdominal

walls, the suction action of the diaphragm, and the peristaltic movements of the intestines In disease other factors come into play some hindering and others assisting absorption.

Amongst the chief additional factors which assist absorption are—(1) phagocytosis, (2) increased intra abdominal pressure (3) endothelial exfoliation.

Those which diminish absorption are—(1) diminution of respiratory movements (2) diminution of peristalsis, (3) fibrinous deposition upon the peritoneal surface (4) agglutination of intestinal coils and omentum (5) lowering of intra abdominal pressure by laparotomy (6) toxæmic fall in blood pressure

Defences of the peritoneum against bacterial infection.—The introduction of foreign matter whether sterile or not is the signal for the appearance in the peritoneal cavity of an effusion of fluid rich in leucocytes, their number varying with the nature of the foreign matter Any lesion of a peritoneum-covered organ such as the strangulation of a coil of intestine inflammation of the appendix, or the twisting of the pedicle of an ovarian cyst, is rapidly followed by the appearance in the fluid of a white staphylococcus of extremely low pathogenetic properties (Dudgeon and Sargent) with its appearance the exudate becomes rich in leucocytes and it is upon the phagocytic action of these white cells assisted by the body fluids, that the removal of the pathogenetic organisms chiefly depends If this defensive reaction has time to become well marked before any large quantity of infective material has gained access to the peritoneal cavity the peritonitis which has started at the point of entrance of the infection may be stopped from becoming diffused over a fatally large area, either by complete absorption or by loculation of the effusion. This shutting off process is brought about by the gluing together of adjacent peritoneal areas with a plastic exudate and is assisted by the diminution of respiratory and peristaltic movements. The fibrinous deposit upon the peritoneal surface also serves to limit the absorption of toxins into the subendothelial blood vessels and to entangle and hold harmless a certain amount of the foreign matter until such time as it can be gradually and safely removed by phagocytosis (Plate 99)

INJURIES OF THE PERITONEUM

1 WOUNDS AND CONTUSIONS

The peritoneum is rarely injured either in open wounds or by contusions, sufficiently to cause clinical symptoms apart from concomitant damage to the abdominal viscera. The visceral injury at first overshadows that of the peritoneum later the resulting peritonitis becomes the predominant feature Contusions of and hæmorrhage



Fig. 1.—Section of intestine from case of peritonitis of sixteen hours' duration showing inflammatory deposit which becomes less as the mucous coat is approached. (B eyepiece; [illegible] obj.)

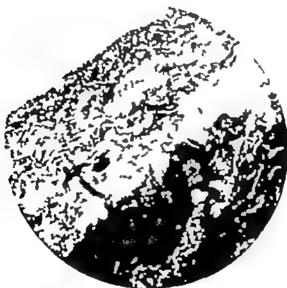


Fig. 2.—Section of diaphragm, showing organization of fibrinous deposit in case of chronic septic peritonitis. (B eyepiece; [illegible] obj.)

PLATE 99

swelling can be felt. The diagnosis has therefore to be made by exploratory laparotomy. A small quantity of blood is often present within the abdominal cavity when the hæmatoma is a large one even though there may be no lesion of the overlying peritoneum to be seen with the naked eye. When a diffuse retroperitoneal hæmorrhage is found the wound should be closed without drainage for the blood will be absorbed spontaneously. Even a large perinephric swelling may be so absorbed, though incision may be required for secondary suppuration of the hæmatoma. During the Great War this treatment had to be modified owing to the frequency with which wounds were infected with anaerobic organisms: it was necessary to excise all the damaged and devitalized tissues, and, according to the exigencies of the campaign, either provide adequate drainage or carry out primary suture.

DISEASES OF THE PERITONEUM

I. INFLAMMATORY

A. ACUTE DIFFUSE PERITONITIS

Definition.—A spreading inflammation of the peritoneum which is unlimited by adhesions. To this form the term "general peritonitis" is sometimes applied, but it is best abandoned as incorrectly implying that the whole peritoneal surface is involved.

The cause of such peritoneal inflammation is in all cases bacterial infection. A spreading inflammation can be caused by injection into the peritoneal cavity of sterile irritating fluids, and to these experimental forms the terms "aseptic" and "chemical" peritonitis were formerly applied. In the same way it was long thought that peritonitis resulting from hæmorrhage into the unopened peritoneal cavity could cause a "chemical" peritonitis, and the same expression was also formerly applied to the peritonitis which occurs in the early stages of intestinal obstruction. Bacteriological examination of the peritoneal surface, especially that covering the great omentum, as well as of the exudate, has thrown grave doubt upon the existence of a non-bacterial peritonitis.

According to Dudgeon and Sargent, the *Staphylococcus albus* appears to have a distinct and definite part to play in peritonitis. It makes its appearance early in inflammatory affections of the peritoneum, from whatever cause they may arise, and can be isolated from the exudate and from the surface of the bowel or omentum. It is found in the sacs of strangulated hernias and in the clot from an intraperitoneal hæmorrhage, as well as in the early stages of inflammation or strangulation of the abdominal viscera. It is probably

protective in function determining the appearance of a fluid exudate rich in phagocytes which do not degenerate in its presence, and having also to do with the formation of adhesions.

Just as the resistance of the peritoneum to infection can be artificially raised by the preliminary injection of various sterile fluids, notably nucleic acid (von Mikulicz) so the injection of a culture of the white staphylococcus into the peritoneal cavity of an animal is able to protect it against an otherwise fatal dose of the colon bacillus (Dudgeon and Sargent)

Many different organisms are found to cause peritonitis in man the most important by far being the colon bacillus. These organisms vary greatly in pathogenicity as regards the peritoneum. The most virulent is the *Streptococcus pyogenes* and next to that the *Bacillus pyocyaneus*. The colon bacillus is sometimes extremely virulent, the differences in behaviour being due to the particular strain present, and to the patient's powers of resistance. The course of a case of peritonitis depends upon many factors, the chief of which are the nature and virulence of the infecting organism, the dosage, the suddenness with which the peritoneum is invaded and the power of resistance of the individual patient.

Infection may reach the peritoneum by many different channels —

(a) From the exterior of the body either through an accidental or an operation wound or along the Fallopian tube
(b) From some part of the alimentary canal.
(c) From disease of an adjacent organ other than the alimentary canal, such as the gall bladder or the pancreas
(d) From an adjacent focus of infection, such as a retroperitoneal abscess or an inflamed ovarian cyst.
(e) From the blood-stream (hæmic infection)

The following are the most common forms of acute diffuse peritonitis —

1. Colon Bacillus Peritonitis

The great majority of these cases originate from disease of the vermiform appendix. Perforation of that organ is a frequent though not a necessary starting point, for the colon bacillus can infect the peritoneum through an acutely inflamed or gangrenous though unperforated appendix it may spread from an imperfectly localized collection of pus around a diseased appendix or it may result from the rupture of an appendicular abscess. Other causes of colon bacillus peritonitis are—penetrating wounds, contusions or lacerations of the intestine intestinal obstruction of any kind perforation of any form of ulcer simple or malignant, of the intestine acute inflammation, gangrene, or perforation of the gall bladder acute pancreatitis

suppuration and rupture of an ovarian cyst and inflammation, gangrene, or perforation of a Meckel's diverticulum.

The exudate in these cases is usually large in amount that in the immediate neighbourhood of the causative lesion is turbid, and may be, but is not necessarily of an offensive odour whilst in more remote parts of the peritoneal cavity it is less turbid and odourless. Cover slip preparations from this odourless exudate usually show innumerable leucocytes and cocci in the exudate nearer the focus of infection are seen cocci, bacilli, and phagocytes, many of which are degenerated. As the peritonitis spreads, bacilli are found in the exudate farther and farther from the focus of infection the intestinal coils become progressively more reddened, distended, and agglutinated and flakes of fibrin are found both floating in the exudate and adherent to the inflamed peritoneum.

2. Acute Streptococcal Peritonitis

The *Streptococcus pyogenes* may reach the peritoneum by direct infection through accidental or even operation wounds, in puerperal sepsis, and by the blood-stream in septicæmia and possibly it may in some cases come from disease of the alimentary canal or from an infected ovarian cyst. It also occurs as a terminal event in some cases of cutaneous erysipelas. It is the most rapidly fatal variety of peritonitis, in part perhaps because it takes the form, when originating from the uterus, of a rapidly spreading subserous cellulitis (Murphy) in part certainly because the intraperitoneal phagocytosis appears powerless against this form of infection.

There are no distinctive appearances by which streptococcal peritonitis can be recognised at operation. As a rule, the exudate is large in amount, odourless, and only slightly turbid intestinal distension is not great, and agglutination of coils is absent fibrinous flakes are scanty or absent. Cover slip preparations show chains of cocci, together with large numbers of polynuclear cells, apparently in a healthy state but non phagocytic as regards the streptococci There is little doubt that the terminal event in most of these cases is a streptococcal septicæmia.

3 Acute Pneumococcal Peritonitis

While this form of peritonitis is more commonly secondary to some pre-existing pneumococcal lesion elsewhere, it does occur as a primary affection. When *primary* the pneumococcus may reach the peritoneum through the blood, and possibly more directly from the bowel it has been known to extend from a pyometra along the Fallopian tube (Dudgeon and Sargent) When *secondary* the infection may come from a neighbouring pneumococcal affection, such as pleuritis or the peritonitis may be septicæmic in origin, the peri-

toneum being then infected through the blood-stream from some focus at a distance, such as an otitis media. The pneumococcus is said to have been found in the exudate in a certain number of cases of gastric perforation. The exudate in pneumococcal peritonitis is usually large in amount and greenish in colour contains a quantity of fibrinous flakes, and is quite odourless. There are, however no definite clinical signs by which it can be recognised, the only certain method being the bacteriological examination of the exudate. It may be suspected if there is great abdominal distension with relatively little rigidity combined with a high temperature, and at operation if the exudate shows the above-mentioned characteristics, whilst no definite lesion can be found to account for the peritonitis, especially when the patient is a child.

4. Acute Gonococcal Peritonitis

Acute diffuse gonococcal peritonitis is occasionally met with. The organism reaches the peritoneum either through the open mouth of a Fallopian tube, or by leakage from or rupture of a pyosalpinx. It does not readily affect the peritoneum, and when it does so is apt to produce a form of peritonitis which although sometimes of sudden or acute onset, usually runs a mild and favourable course, and is unaccompanied by intestinal distension. The exudate is scanty usually clear or only very slightly turbid, and distinctly viscid. Cover-slip preparations occasionally show intracellular diplococci.

5. Other Forms of Acute Peritonitis

The organisms more rarely found in acute diffuse peritonitis are *B pyocyaneus*, *Staphylococcus pyogenes aureus* and other forms of pyogenetic staphylococci, and *B typhosus*. The last named may reach the peritoneum from a suppurating mesenteric gland (Körte) and perhaps from the intestine without perforation. The peritonitis resulting from perforation of a typhoid ulcer is a mixed infection, the colon bacillus predominating.

Veillon and Zuber have described certain anaerobic organisms as occurring in peritonitis, as also have Tavel and Lanz. Dudgeon and Sargent only once found an anaerobic organism, namely the *B aerogenes capsulatus* and consider that anaerobes do not play an important part in peritonitis. During the late War anaerobic infection of the peritoneum was almost unknown, while that of the retroperitoneal tissues was common

Symptoms of acute diffuse peritonitis.—The clinical history and symptoms of the disease or injury which has allowed the infection to reach the peritoneum are dealt with elsewhere. In the later stages the peritoneal symptoms so overshadow those of the

original lesion that in the majority of cases its nature can only be ascertained by the operation which the peritonitis makes imperative

The onset is often sudden, or at least rapid, and is accompanied by *abdominal pain*. At first diffuse, the pain may after a short time become sufficiently localized to be of diagnostic value later again, it becomes generalized over the whole abdomen.

Vomiting is a symptom which is rarely absent. It is persistent, and accompanied by nausea and straining, differing in these respects from the vomiting of intestinal obstruction The vomitus is commonly green in colour and does not become fæculent. The occurrence of "black vomit" is one of the most serious symptoms in a bad case of peritonitis. *Constipation* is present from the outset and becomes more marked with the progressive paralysis of the intestine. The tongue, at first furred and moist, soon becomes dry and brown.

The *temperature* affords little information. At the onset it may be subnormal from the shock of a perforation or strangulation on the other hand, it is often raised at first, and sometimes the onset is marked by a rigor. As the peritonitis spreads, the temperature falls to and below the normal.

The *pulse-rate* is of much greater importance. Rapid at the onset, it may become slowed as the initial shock passes off, only to rise again steadily and progressively with the spread of the peritonitis. At the same time it becomes feeble and "thready" One of the most reliable indications of a spreading peritonitis is the coexistence of a rising pulse-rate and a failing temperature.

The *facies* is important. The patient quickly assumes a characteristic appearance, the face being pale, drawn, and anxious-looking, whilst dark rings appear round the sunken eyes. The *mental condition* is clear and in fatal cases the patient may be only too conscious of his condition until the end.

Examination of the abdomen by inspection, palpation and percussion should be thoroughly and systematically carried out. The abdomen is *rigid* and often extremely *tender* and the abdominal *respiratory movements are diminished* In the early stages this rigidity and the diminution of respiratory movements may be so localized as to afford valuable evidence as to the situation of the starting point of the peritonitis. Later, the whole abdomen becomes rigid and motionless. As the disease progresses, the abdomen, which may at first have been flat, or even sunken, becomes progressively *distended* from intestinal paralysis, and the distension may become so great as seriously to interfere with respiration. The presence of free fluid may sometimes be ascertained by the somewhat fallacious sign of *shifting dullness* in the flanks.

In peritonitis from intestinal perforation there may in addition

be evidence of *free gas* in the peritoneal cavity. This is shown by diminution or absence of the normal area of liver dullness, especially when it occurs in a flat abdomen in the axillary line. Its presence in the nipple line is often simulated very closely by intestinal obstruction.

In old persons many of the above-mentioned symptoms may be absent. The abdomen is sometimes observed to be both soft and mobile, even in the presence of an acute spreading peritonitis. Similarly both rigidity and immobility may be absent in postoperative peritonitis.

Nearly all these symptoms and signs may be modified or abolished by the administration of opium. A patient under its influence may look comparatively well, vomiting may be absent, the pulse may be only slightly accelerated, the abdomen may be soft and moving with respiration, and examination may not be resented.

Diagnosis.—Acute peritonitis has to be diagnosed from intestinal obstruction, the clinical features of which are detailed at p. 477. In addition to establishing the fact that diffuse peritonitis is present an attempt must be made to ascertain the starting point of the peritoneal infection.

Treatment.—The presence of acute diffuse peritonitis urgently demands operation, every hour that passes between onset and operation rendering the prognosis increasingly grave. Whilst preparations are being made for the operation the patient should not be allowed to lie flat upon the back, but should be propped up in bed almost in a sitting posture (Fowler's position, Fig. 466, p. 651). If he has to be transferred to hospital a similar posture should be adopted on the journey.

The operation consists of two essential parts, namely, the removal of the focus of infection, and the treatment of the peritoneum.

1. Removal of the focus of infection.—If before operation a decision has been arrived at as to the source of the infection, the abdomen should be opened as nearly as possible over that point. When the source of infection is uncertain, the most generally useful incision is the paramedian, which displaces the right rectus muscle outwards just below the umbilicus, as this allows the appendix region to be explored at once, and also gives easy access to the pelvic organs. The methods of dealing with any particular lesion that may be found are discussed elsewhere under various headings, such as Removal of the Appendix (p. 569), Suture of a Ruptured Gastric Ulcer (p. 371), and so on.

2. Method of dealing with the peritoneum.—The error of attempting to cleanse the peritoneum by heroic methods of lavage has been amply demonstrated both by clinical results and on pathological grounds. No amount of washing will rid the peritoneum of infective

material while the disturbance occasioned by such manipulations tends to spread infection beyond the area already involved, destroys the phagocytes which alone can effectively deal with the micro-organisms, injures the delicate peritoneal endothelium so rendering hæmic absorption more easy and increases the shock of the operation. Once the focus of infection has been removed, the less that is done to the peritoneum the better and all manipulations ought to be of the gentlest possible character Any collection of pus which may lie in the immediate neighbourhood of the starting point of the infection, and any pools of fluid that may have collected in the pelvis or the lumbar region, may be gently mopped up with dry sterilized gauze. On no account should flakes of lymph be peeled off the bowel.

This done, a drain made from a roll of sheet rubber may be inserted down to the site of the lesion, either through the original wound or through some new opening—in the loin, for example—which may be considered more suitable for drainage. Gauze strips are sometimes used for this purpose, but they do not act well as drains, and their removal is attended by considerable pain. The "cigarette' drain, which consists of a piece of green protective or rubber tissue wrapped round a loosely arranged roll of gauze in the form of a cigarette, is sometimes used, but is not so effective as a roll of rubber.

Sometimes lavage of the peritoneal cavity is advisable, as in those cases of ruptured gastric or duodenal ulcer in which the peritoneal cavity is flooded with acid gastric contents and solid particles of food, and in certain cases of intraperitoneal hæmorrhage when it is desirable to wash away large quantities of blood and clot. In such instances the interference with intraperitoneal phagocytosis is of less moment than the desirability of ridding the peritoneum of foreign matter. Drainage is only necessary when there is a localised collection of pus or a possibility of leakage from the intestinal wound.

After-treatment.—Posture is important. The Fowler position is now widely adopted, the patient being propped up almost in a sitting position, with the object of preventing the gravitation of fluid upwards towards the diaphragm (Fig 466 p. 651) If this position be used careful watch should be kept for any collection of pus in the pelvis.

When the patient has been put back into bed every effort must be directed towards combating shock. The various means of dealing with *this condition are explained in Vol. I p. 353.*

It is of the utmost importance to get the bowels opened freely as soon as possible a dose of calomel may be followed by repeated doses of magnesium sulphate until a free action is obtained, and enemata containing turpentine are often useful Subcutaneous injection of pituitary extract (ᛘxv of a 20-per-cent. solution) or of eserine sulphate (gr $\frac{1}{100}$) appears to be useful in stimulating peristaltic action.

The continuous administration of saline solution per rectum by Murphy's method has many advocates, and good results are obtained by its use. A pliable tube of soft metal provided with many openings, is inserted in the rectum and connected with a reservoir containing normal saline solution maintained at a temperature of 103° to 110° F. The reservoir is raised from one to two feet above the level of the buttocks, and the fluid allowed to run slowly in. By this means some twelve or more pints of fluid can be absorbed in a day. Care must be taken to keep the quantity within reasonable limits, lest the lungs become waterlogged.

If drains have been used, they should not be allowed to remain in place for more than two or three days. By that time they will have done all that can be done by drainage, and longer retention may be followed by a troublesome sinus and an unnecessary weakening of the abdominal wall.

Vomiting may be controlled by small repeated doses of tincture of iodine or of cocaine; sometimes gastric lavage may be advantageously employed.

The use, in cases of *B. coli* peritonitis, of a multivalent anti-coli serum has yielded promising results, and may be given a trial.

Complications of acute diffuse peritonitis.—Most of the fatal cases terminate by septic intoxication, and many from a general septicæmia. When with the removal of the focus of infection, and the placing of the peritoneum under the best conditions for dealing with the remaining infection, death from these causes has been averted, the chief complications to be looked for are the following:—

1. **Intestinal obstruction.**—Paralytic distension is very common and, unless peristaltic action is quickly restored, death from septic absorption will soon occur. But, apart from this paralytic form of obstruction (ileus duplex of Sampson Handley), mechanical obstruction may occur from adhesions and kinking of the bowel. This is shown by inability to get the bowels open in spite of the presence of peristalsis by increasing distension, and by renewed vomiting which sooner or later becomes fæculent in type. A further operation (enterostomy or enterolysis) may possibly succeed, but the outlook in such cases is extremely grave.

2. **Cellulitis and gangrene** of the abdominal wall around the wound are occasional, but very uncommon, complications.

3. **Residual abscesses.**—After the subsidence of a diffuse peritonitis a localized collection of pus may appear anywhere within the peritoneal cavity. One variety is the subphrenic abscess (see p. 588), whilst after the use of the Fowler position a pelvic accumulation of pus may occur; the latter should be suspected if mucus is passed per rectum.

4. Pneumonia and empyema.—These complications sometimes occur within the first week or fortnight after the operation for diffuse *peritonitis*.

B LOCALIZED INTRAPERITONEAL SUPPURATION

Localised collections of pus within the peritoneal cavity may result from a large number of different causes. The commonest variety is the localized appendicular abscess; others are due to disease of the female pelvic organs to slow leakage from a gastric or duodenal ulcer to inflammatory processes around a cancerous growth of the intestine, and to disease of the gall bladder bile-ducts, or pancreas others are those already described as 'residual' abscesses, which may occur in any part of the peritoneal cavity after the subsidence of a diffuse peritonitis whilst others, again are due to the chronic forms of tuberculous or pneumococcal peritonitis, to be described later Suppurative epiploitis constitutes still another variety of localized abscess.

The situations in which such abscesses tend to form have already been indicated in describing the anatomy of the peritoneal compartments; but adhesions not infrequently alter the course of a tracking collection of pus, and occasionally perforation of the peritoneum forming the abscess wall may allow the pus to escape into the retroperitoneal tissue, so as to form an abscess in situations uninfluenced by the anatomical disposition of the peritoneum.

In addition to the symptoms of the disease from which the abscess originated, those presented by a localized intraperitoneal abscess are abdominal pain and tenderness, together with toxæmia. The course *may be very slow and the diagnosis difficult In the simpler* cases a firm and definite intra-abdominal tumour may be felt; others have to be diagnosed by the general symptoms, added to those of pressure effects upon neighbouring structures such as the base of the lung

One variety of localized abscess must be considered separately namely, subphrenic or subdiaphragmatic abscess.

Subphrenic Abscess

Definition—A collection of pus beneath the diaphragm, lying on the right side between the liver and diaphragm, and on the left between the diaphragm and the stomach and spleen. The term is often used to include abscesses situated in the right kidney wall when the pus is really subhepatic rather than subphrenic.

Causation.—The possible causes of subphrenic abscess are very numerous, for almost any intra-abdominal lesion may give rise to it, whilst occasionally the spread is in the reverse direction, suppuration above the diaphragm giving rise to infection below The most common

causes are perforation of an ulcer of the stomach or duodenum suppurative conditions of the liver and its ducts, and appendicitis. Renal, pancreatic, and traumatic suppurations are occasional causes.

Pathology—The bacteriology of subphrenic abscess is as varied as that of peritonitis. Pus spreading from the primary focus may find itself at once in the subphrenic region, or it may reach this region from a distance traversing intraperitoneally the anatomical routes already considered or paths determined by adhesions, or occasionally spreading in the retroperitoneal tissue of the posterior abdominal wall. Perforation of the diaphragm is said to be more likely to occur in the last named class of case. In a certain number of cases (about 15 per cent.) the cavity of a subphrenic abscess contains gas, which may be present either as the result of bacterial activity within the abscess, or may have gained admission by direct continuity from the alimentary canal, or even from the air passages.

Symptoms and diagnosis.—The onset may be very acute and present most of the features of an abdominal catastrophe it may be subacute, with pain in the upper part of the abdomen, fever and possibly a rigor and pain in the shoulder is common. Pain and tenderness over the lower ribs, and limitation of the respiratory movements, together with cough slight expectoration, and irregular fever following upon a history of gastric ulcer an operation for suppurative appendicitis, or other recognizable cause of subphrenic suppuration would make up a clinical picture of such a case The onset may on the other hand, be so slow and insidious, and present so few localising symptoms and physical signs, as to make the diagnosis a matter of the greatest difficulty

As the symptoms and causes vary within such wide limits, so also do the physical signs. Broadly speaking, the physical signs are those of a limited collection of fluid at the base of the lung In a well marked case there may be an area of dullness sharply marked off from the resonance of the lung above, together with loss of breath-sounds and diminution or loss of vocal fremitus and resonance. When the abscess contains gas there may be on percussion a characteristic series of changes from the dull area below through a tympanitic area up to the normal pulmonary resonance. Alteration of the position of the patient may cause alteration of the position of the resonant area as the gas and pus adjust themselves to the new position.

The lower lobe of the lung may be so compressed as to present a zone of tubular breathing and impaired resonance above the level of absolute dullness. If the collection is a large one, the liver may be pushed downwards so as to be easily palpable below the costal margin the heart may be displaced upwards. A screen examination with the X rays sometimes proves most valuable by indicating the level and

degree of mobility of the diaphragm. There is no lateral displacement of the heart.

The diagnosis is often complicated by the presence of clear or purulent fluid in the pleural cavity above the subphrenic collection. The diaphragm is sometimes perforated so that the subphrenic and pleural collections of pus communicate with one another.

Exploratory puncture with an aspirating needle cannot be too severely condemned. The procedure is far more dangerous than an exploratory operation, and a negative result is valueless.

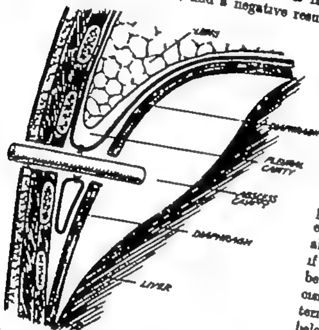


Fig. 445.—Diagram showing structures traversed in opening a subphrenic abscess.

Treatment.—The abscess must be opened as soon as its presence has been determined. The actual site of the opening will be indicated by the situation of the pus, as shown by percussion, position of tenderness, palpation, and X-ray examination. Occasionally such an abscess, if coming forward, can be reached by an incision through the anterior abdominal wall below the costal margin and posteriorly situated collections have been reached by an incision below the costal margin behind, though in doing this there is risk of accidentally wounding and infecting the pleura.

The method adapted to the majority of cases is that of deliberately traversing the pleural cavity and diaphragm. The structures which have to be traversed are shown diagrammatically in Fig. 445. If the patient is very ill the operation can be done under local anaesthesia.

The operation, briefly, consists in resecting portions of two or three ribs over the site of the abscess, opening the pleural cavity, suturing the diaphragm to the costal pleura, so as to shut off the pleural cavity, incising the diaphragm and inserting a drainage-tube. Some surgeons prefer to perform this operation in two stages, the first stage

being directed to shutting off the pleural cavity and the second to opening the abscess. The danger of infecting the pleura in the one-stage operation has been exaggerated and there is little to be said in favour of the two-stage procedure. In some cases an empyema is present in addition to the subphrenic abscess when this is so doubt may arise as to whether there is also pus beneath the diaphragm the operator would then be content to drain the empyema and to await events.

Prognosis.—Rare instances have occurred of spontaneous termination either by absorption or evacuation of the pus. With such reported exceptions the condition, if unrelieved by operation, terminates fatally sometimes after a very prolonged period of illness. Extension or rupture of the abscess may take place into the pleural cavity the pericardium, the bronchi or the general peritoneal cavity and the patient dies from these complications or from prolonged suppuration and septic poisoning. Early operation, on the other hand, offers a fairly good prospect of recovery and the mortality of such cases may be placed at between 30 and 40 per cent.

There is a tendency to the formation of fresh loculi of pus even after the primary collection has been evacuated, and in the event of the temperature not subsiding, fresh efforts should be made to find such collections.

C. CHRONIC FORMS OF PERITONITIS

1. Chronic Septic Peritonitis

Localized intraperitoneal abscess has already been considered (p. 588) A form of peritonitis intermediate between these cases and those of acute diffuse peritonitis can sometimes be recognized, coming on after the subsidence of an acute diffuse peritonitis, and characterized clinically by irregular fever of a mild type, diarrhœa and progressive emaciation from time to time collections of pus large enough to be recognized and opened may make their appearance The termination is almost always fatal. Post mortem there is a general matting together of the abdominal contents, in the midst of which may be found loculi of pus of various sizes which often communicate with one another by narrow fistulous tracks, and an extreme thickening of the peritoneum from fibrinous deposit more or less organized (Plate 99 Fig 2) In such cases the pyogenetic staphylococci, the colon bacillus and the *Bacillus pyocyaneus* have been found. This variety of peritonitis is a common sequel to gunshot wounds of the small intestine and its long duration and often mild symptoms were responsible for the number of cases of recovery from penetrating abdominal wounds, not treated by operation, that were reported during the South African and the early period of the late War

2 Chronic Gonococcal Peritonitis

The gonococcus whilst only an occasional cause of acute diffuse peritonitis, frequently produces a chronic form of peritonitis which, from its almost invariable starting point in the Fallopian tubes, chiefly concerns the pelvic peritoneum. The resulting peritonitis is slow and insidious in its course, produces few or no symptoms apart from those of the initial lesions, and leads to the formation of adhesions which may mat together the pelvic viscera and may cause intestinal obstruction.

3 Chronic Pneumococcal Peritonitis

Like the gonococcus, the pneumococcus may produce either an acute and diffuse, or a localized and chronic peritonitis. The chronic form closely resembles tuberculous peritonitis, both in its clinical course and in its local effects upon the peritoneum, and the two diseases can scarcely be distinguished except by a bacteriological examination. The diagnosis may have to rest upon the discovery of some recognizable pneumococcal or tuberculous lesion elsewhere

D TUBERCULOUS PERITONITIS

The forms in which peritoneal tuberculosis occurs are—

1 The miliary form, in which the peritoneum is affected merely as part of a general miliary tuberculosis This form is of no surgical interest.

2 A form in which the peritoneal affection is either primary or—being secondary as is more common—constitutes the predominant feature of the case.

The infection reaches the peritoneum either through the blood-stream from some focus at a distance such as the lung or more directly from a neighbouring focus, such as an intestinal ulcer a tuberculous mesenteric gland, or a tuberculous Fallopian tube.

Clinically the disease appears in two chief varieties, which, however merge into one another namely the *ascitic* and the *adhesive*. In the former the exudation is the chief clinical feature the peritoneum being studded with tuberculous nodules of varying sizes in the latter the intestines and omentum are matted together in an inextricable mass, in the midst of which are collections of broken-down caseous material of various sizes. Such collections are liable to become secondarily infected with pyogenetic organisms from the intestine, and to form acute or subacute intraperitoneal abscesses With one or more of these abscesses the intestine may communicate by fistulous tracks, and such abscesses becoming adherent to and perforating the abdominal wall, or being opened surgically may produce intractable fecal fistulæ. The umbilicus is a common site for such a fistula to arise spontaneously

Symptoms.—Tuberculous peritonitis is chiefly a disease of childhood and young adult life, though it is sometimes met with in older patients. It runs a slow course, and is characterised principally by progressive emaciation which may be accompanied by irregular slight fever. Attacks of pain and vomiting occur at intervals, but, unless proceeding from a definite intestinal obstruction, they are not severe. In some cases diarrhœa is a marked feature. Secondary infection of intraperitoneal abscesses may cause more acute symptoms and may necessitate incision.

Examination of the abdomen reveals, in the ascitic variety, the physical signs of free fluid within the abdomen. The distension may become extreme, so that the belly wall appears tense and shiny, with dilated veins upon its surface and a prominent umbilicus; respiratory and cardiac embarrassment may thus be caused. The fluid may find its way into a patent funicular process, and, unless there is something to call attention to the abdomen, such a case may easily be mistaken for one of simple congenital hydrocele.

In the adhesive variety it is often possible to feel nodules or irregular masses of various sizes scattered throughout the abdomen.

Diagnosis.—A characteristic case presents little difficulty, though it may be closely mimicked by the chronic form of pneumococcal peritonitis.

On the other hand, tuberculous peritonitis may assume forms in which the diagnosis is a matter of the greatest difficulty and may have to be decided by exploratory laparotomy. Thus, *malignant disease of the peritoneum*, especially when accompanied by the presence of palpable masses and of ascites, may be quite indistinguishable from tuberculous peritonitis except by surgical exploration. An encysted collection of fluid in tuberculous peritonitis may readily be mistaken for an *ovarian cyst*, or for a *local intraperitoneal abscess due to some other cause*.

In a case with acute onset accompanied by fever and diarrhœa, the diagnosis from *enteric fever* may be most difficult. The greater irregularity of the fever, especially when observed over a period of several weeks, together with the absence of rash, of splenic enlargement, and of bronchitis, and the negative Widal reaction, would serve to distinguish tuberculous peritonitis. Some assistance may be gained from Calmette's or von Pirquet's tuberculin tests.

Treatment.—Treatment by medical means, hygienic and dietetic, such as is suitable for tuberculosis in general, may be followed by good results. Tuberculin may also be tried in suitable cases. The tapping of a large ascitic collection may afford relief, but does not give such good results as laparotomy, and is by no means free from the risk of puncturing adherent intestine.

Treatment by surgical means is often indicated, and is frequently

followed by results sufficiently good to be justly denominated cures It is chiefly in the ascitic form that operation holds out such favourable prospects. The operation is of the simplest character and consists in opening the abdomen through a small paramedian incision, some two or three inches long, and allowing the fluid to escape the little wound is then closed and dressed with collodion. No advantage appears to attach to the flushing or mopping-out of the peritoneal cavity still less to the introduction of antiseptics. Occasionally a definite tuberculous focus of origin can be removed at the same time, such as a Fallopian tube or a lymphatic gland. The coexistence of phthisis or other tuberculous focus, unless of an advanced character is no contra indication to operation.

Other operative measures are called for in certain cases, as for the relief of intestinal obstruction, or the opening of localized infected abscesses. When fistulæ are present, no surgical procedure is likely to be of any benefit.

Prognosis.—The immediate result of operation in the ascitic form and in dealing with encysted collections of exudate, is strikingly beneficial, whilst the operative risk is very small.

II. TUMOURS

The *peritoneum is often involved secondarily by malignant growths*, but is rarely the seat of a primary tumour Other neoplasms, described as peritoneal tumours, such as lipomas, are in reality connective-tissue tumours of the retroperitoneal tissues.

Carcinoma and sarcoma of the gastro-intestinal tract, uterus, ovaries, and biliary passages often involve the peritoneum, the affection taking the form of nodules of growth of various sizes everywhere studding the serous membrane and involving in particular the omentum, which tends to become rolled up into cake-like masses, especially in the upper part of the abdomen. The growth may consist of hard nodules, but is sometimes of gelatinous consistency

Effusion of fluid into the peritoneal cavity is the rule, the fluid being clear or straw-coloured and often blood-stained.

The symptoms of such peritoneal involvement by malignant growth are usually overshadowed by those of the primary tumour Sometimes, however the primary growth is small and so situated as to produce no symptoms, in which case those of the peritoneal involvement will predominate. The existence of ascites together with the presence of nodules or large masses palpable on abdominal examination, in a patient of or beyond middle age would point to the possibility of intraperitoneal carcinomatosis Similar cases of sarcomatosis occur in

children and young people, and such a condition may be very difficult to distinguish from tuberculous peritonitis (see p. 592)

The treatment can only be symptomatic.

HYDATID CYSTS

These cysts sometimes arise primarily in the omentum. Multiple hydatid cysts occasionally result from rupture into the peritoneal cavity of a primary cyst in the liver or elsewhere.

MESENTERIC CYSTS

Apart from hydatids, the origin of mesenteric cysts is obscure. They are usually unilocular contain clear or milky fluid, and may attain a very large size. Possibly traumatism accounts for a certain number of the cases, though it is more likely that the injury merely calls attention to a cyst which had previously caused no symptoms.

The presence of a freely movable painless tumour is usually all that the clinical picture presents, though indefinite pain or intestinal disturbance may call attention to the disease. The diagnosis is usually only made with any certainty by exploratory operation.

Treatment.—Removal by means of an incision through the overlying mesenteric peritoneum, with due regard to the position of the intestinal blood vessels, is the most satisfactory method. When the cyst cannot be so shelled out without risk of damage to the blood supply of the overlying or adjacent intestine, it may be brought up to the abdominal wound and opened, the lips of the incision in the cyst being sutured to the abdominal wall and a tube or gauze drain inserted.

III. ASCITES

Any non-inflammatory collection of serous fluid in the peritoneal cavity is called ascites. It is the result of such circulatory disturbances as arise from cardiac or pulmonary disease from portal obstruction of hepatic origin, such as cirrhosis or from renal disease. It is therefore not a disease of the peritoneum, but a secondary transudation of fluid into the peritoneal cavity symptomatic of disease elsewhere.

SELECTED BIBLIOGRAPHY

Box, C. R., *Lancet* March 26, 1910.
Box and Eccles, *Clinical Applied Anatomy* London, 1906.
Barton and Terrey *Journ. of Med. Research*, xiv 5.
Dudgeon and Sargent, *Bacteriology of Peritonitis.* London, 1905.
Durham, H. E., *Med.-Chir. Trans., London*, lxxx. 101.
Gohn, A., *Wien. klin. Woch.*, 1904, xvii. 207
Handley, W Sampson, *Brit. Journ. Surg.*, 1915, No. 10 p. 161
Lennander *Mitteil. Grenz.*, 1902.
MacCallum, *Johns Hopkins Hosp. Bull.*, 1903, xiv
von Mikulicz, Cavendish Lecture, 1904.
Muscatello, *Virchow's Arch.*, cxlii.
Ramstrom, Inaug. Dissert., Wiesbaden.
Veillon et Zuber *Arch. de Méd. Expér.*, July 1898.

HERNIA

By LAWRIE McGAVIN C.B.E., F.R.C.S.
Revised by C. C. CHOYCE

Structure of a hernia.—With certain exceptions a hernia consists of (1) a sac, (2) its coverings, and (3) its contents.

In some hernias, to be described later the sac is partially or wholly absent, and in some, although present, it may be devoid of contents from time to time

The **hernial sac** consists of peritoneum, and is either present at birth, or is formed subsequently as the result of pathological changes in the abdominal wall. It is usually described as having a neck, a body and a fundus.

The *neck* is that part which occupies the aperture through which the hernia escaped. It is commonly narrow being constricted by the surrounding tissues and when unoccupied is flattened from before backwards. Occasionally however it is the widest part of the sac. In its earliest condition the peritoneum of the neck resembles that from which it springs it is quite free from the surrounding structures, and is lined by normal glistening endothelium. In children it is very thin, and in all inguinal or femoral hernias the posterior wall is thinner than the anterior

The *body* is usually wider than the neck and is at first unilocular Subsequently it may enlarge to remarkable dimensions and become altered in character A sac may exist which has never been occupied by contents in which case it rarely attains to great size and may retain the original character of the parietal peritoneum.

The *fundus* or extreme end is usually though not always, the oldest part of the sac Since the iliac peritoneum is more readily dragged down than the parietal there is in inguinal and femoral hernias a tendency for the original point of protrusion to lag behind the fundus may thus be formed from the peritoneum which was derived from the iliac fossa.

Formation of hernial sacs.—Hernial sacs may have their origin as—

1 **Preformed (congenital) sacs.**—The opinion is becoming more general that many sacs, hitherto looked upon as acquired

are in reality congenital diverticula This, as pointed out by Hamilton Russell, is especially the case with femoral hernias and probably applies to the inguinal variety as well.

The sacs of *undoubtedly* congenital origin are those which occur (*a*) into the patent vaginal process in the male (*b*) into the patent canal of Nuck in the female (*c*) at the patent umbilical ring in the infant. These are considered later

2 **Distension diverticula (acquired sacs)**—These occur as the result of muscular weakness at certain sites in the abdominal wall, assisted by forced expiratory efforts which repeatedly raise the intra abdominal pressure They are commonly thicker in the wall and more adherent at the neck than the sacs of congenital origin and are often wide-mouthed from the first especially when they are of the variety met with in direct hernia they are frequently multilocular and are rarely empty

3 **Traction diverticula.**—For the formation of a sac by the constant drag of a tumour attached to some portion of the peritoneal surface, the action of gravity is necessary and for this reason such sacs are rarely seen in any position other than the pelvic floor Sacs are, however formed in the inguinal region by the dragging of tumours of the cord or testis, or by the weight of large hydroceles. Lipomas of the spermatic cord are often found at the fundus of a sac, suggesting the possibility that the sac has arisen first by traction and then by distension.

4 **Downward displacement of the peritoneum.**—This method of formation is rare it is usually seen in cases of hernia associated with general enteroptosis (Glénard s disease) and results in the presence of a complete sac only at the *commencement* of the trouble, for in time the iliac peritoneum slips down and what was the posterior wall of the sac becomes first the fundus and then the anterior wall, the posterior wall now being deficient, and its place being taken by the down-slipping cæcum on the right side, or the sigmoid on the left a partial sac is thus eventually formed (Fig 459 p 628) Such sacs are more often met with in direct than in oblique inguinal hernias ("sliding hernias")

The congenital sac.—Prior to birth, two well-recognized processes of peritoneum exist, which should be obliterated when the infant is born. These are (1) the umbilical process, and (2) the funiculo-vaginal process of the testis in the male or the canal of Nuck in the female.

The first rarely persists long containing at birth a small coil of ileum in connexion with Meckel s diverticulum, it commonly closes within a few days. Remaining unobliterated, however it forms the sac of a "congenital umbilical hernia.

The second is more important. In both sexes the inguinal canal is occupied shortly before birth by a tubular process of peritoneum which passes into the scrotum of the male, forming the processus vaginalis of the testis, and in the female into the labium majus forming the canal of Nuck. The latter should be and usually is, entirely obliterated exceptionally it remains patent and forms the sac of a congenital hernia of the canal of Nuck. The former should be obliterated as far as the testis, the remainder forming the tunica vaginalis of that organ. If the



Fig 446 —Sac of hernia into processus vaginalis.

V., Processus vaginalis O., pubes R., rectus muscle.



Fig. 447 —Sac of hernia into funicular process.

S S., Hernial sac; T V., tunica vaginalis; O., pubes; R., rectus muscle.

process remains patent in its whole length and at any time contains viscera, the sac thus formed is that of a congenital hernia of the vaginal process" (Fig 446) If the process is obliterated at the upper pole of the testis but in free communication with the peritoneal cavity above this point, the sac is that of a "congenital hernia of the funicular process (Fig. 447) Two other forms of congenital sac are met with, and are known as "infantile" and encysted infantile." In the first there is what looks like an acquired sac immediately behind, and bulging into, the sac of a congenital hernia of the vaginal process or funicular process (Fig 448) In the second, the neck of the vaginal process would seem to have been obliterated only at the internal

abdominal ring by a septum which having been stretched and forced downwards, has formed a second sac dependent *within the lumen of the first* (Fig 449) A better term for the first of these sacs would be "retrofunicular" and for the second "intrafunicular" It is doubtful if the second sac in the first of these forms is really of congenital origin.

The congenital sac differs but slightly from the acquired sac in its general appearance it is, however usually narrower at the neck less adherent to its surroundings, and freer from thickening and cicatrization of its walls it is frequently empty or contains only fluid.



Fig 448.—Sac of infantile hernia common variety

Processus vaginalis s.s. hernial sac o. pubes rectus muscle.

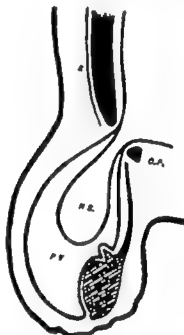


Fig. 449 —Sac of encysted infantile hernia.

Processus vaginalis; s.s., hernial sac; o. pubes r. rectus muscle

Contents of hernial sacs.—In a reducible hernia the contents may vary but in an irreducible one they are usually constant. The commonest content is the *omentum*, owing to its weight length mobility and lobulated character which facilitate its engagement in the hernial orifices. Occasionally its free margin becomes adherent to the posterior edge of the aperture and a part above is invaginated into the sac so as to form an omental lining or "omental sac" the recognition of this condition is important during operation, owing

to the danger of including a contained knuckle of gut when ligating the omentum.

Next in frequency is the *bowel* itself. The part most commonly involved in inguinal and femoral hernias, especially on the right side, is the lower part of the ileum; on the left side, the ilio-pelvic colon is often found. Very rarely the intestinal canal of one side will trespass into a sac of the opposite side. Thus, sigmoid is at times found on the right side (Eccles, Kelly, Griffiths) and appendix, cæcum, and ascending colon have been found in a sac on the left (Owen Richards). Such cases are of extreme rarity and suggest either general enteroptosis, elongation of the mesocolon, or transposition of viscera.

The presence of the *vermiform appendix* in right-sided sacs has been frequently noted, at times in a state of acute inflammation. I have met with such a condition in 4 per cent. of cases.

A *Meckel's diverticulum* may be met with in inguinal sacs, and may be mistaken when much atrophied, for an adhesion band: the discovery of its true nature is thus a matter of some importance.

The *ovary and Fallopian tube* are met with occasionally in inguinal and even femoral sacs, the tube being often adherent at its fimbriated extremity. I have also found a small pedunculated fibro-myoma of the uterus in an inguinal sac.

Although the *bladder* is more commonly found in the extra-peritoneal varieties of hernia, a process of it may present in the sac of an inguinal or a femoral hernia.

The sac of an umbilical hernia rarely contains anything except omentum, transverse colon, and mesocolon; it may however contain small intestine or a Meckel's diverticulum.

Fluid may be found in hernial sacs, and unless due to ascites, points to some local irritation of the sac or its contents. Thus, it is seen constantly in strangulation, or where strangulation has undergone spontaneous resolution; it may also be associated with injury to the sac, with pressure by a badly fitted truss, or at times with localised tuberculous or malignant disease of the sac or its contents.

Loose bodies may be found in hernial sacs, usually in the form of calcareous or fibro-cartilaginous masses varying in size from a pea to a horse-bean; these are usually detached appendices epiploicæ which have undergone secondary histological change.

Diagnosis of hernial contents.—The presence of bowel may be determined from the elastic character of the tumour, the gurgling of fluid and gas when it is handled, the resonance to percussion, the occurrence of visible peristalsis, or the plastic sensation due to the presence of fæces.

Recurrent attacks of pain and tenderness in a right-sided sac,

especially if accompanied by pyrexia and vomiting, but in the absence of definite signs of strangulation, should suggest the presence of an inflamed appendix. Its presence may at times be diagnosed by palpation from the peculiar shape of the organ and from the tenderness on pressure being referred to McBurney's point or to the umbilicus.

Omentum in the sac gives rise to a spongy lobulated mass of ill defined outline, usually irreducible, dull to percussion throughout the length of the inguinal canal, although in the scrotum there may be areas of resonance which are due to bowel. It lacks the tenseness and rounded character of hydrocele and the plastic character of fæces.

The presence of an ovary is generally indicated by tenderness and enlargement of the hernia coincident with each menstrual period, irregularity of these periods, some displacement of the uterus to the side of the hernia and absence of the ovary of that side when a bimanual examination is made. In either femoral or inguinal hernia its characteristic shape and sensation on pressure may be elicited in the quiescent period.

Hernias which contain cæcum colon, or sigmoid are usually very large with wide necks, contain fæces from time to time and are often associated with constipation and incarceration.

It is not always possible to be certain of the presence of the bladder in the sac of a hernia, since only a small part of its wall may be involved, but it should be suspected in all cases of direct inguinal and in femoral hernia accompanied by urinary symptoms whether in the way of frequency pain, strangury or unexplained cystitis and in cases where an overfull bladder is associated repeatedly with an increase and micturition with a decrease, in the size of the hernia. In femoral hernia the bladder should never be forgotten, whether symptoms are present or not, since it is frequently found at operation without any external evidence. Where doubt exists, it may be cleared up by the passage of a sound per urethram, after the bladder has been emptied it may thus be possible, especially in the female, to direct the beak of the sound into the diverticulum in the sac and so avoid an accident during operation.

Coverings of the sac.—These naturally depend on the variety of hernia in question, and will be discussed as each variety is considered.

Secondary changes in the sac.—Although at first a simple protrusion of almost unaltered peritoneum, the sac does not long remain in this condition It is influenced especially by pressure and irritation from without, and by the character and weight of its contents. At first it is thin, avascular usually unilocular and easily reducible into the abdomen but with the constantly increasing

weight of its contents it becomes stretched and tends to grow in length rather than in width, provided no pressure is brought to bear upon it from without.

1 **Thickening of the walls.**—This increase in size demands an increase in nutrition the sac soon becomes adherent to the surrounding structures, develops new vessels on its outer surface, and becomes very much thicker in hernias of large dimensions and long standing the walls may measure as much as an eighth to a quarter of an inch in thickness, and assume the consistence of the pericardium. These changes are chiefly seen in irreducible omental hernias, where the omentum has become widely adherent to the sac wall, which thus receives a blood supply from within as well as from without. Thickening is also favoured by the chronic congestion produced by the pressure of an ill fitting truss upon the veins about the neck of the sac.

2 **Thickening below the neck.**—The changes above mentioned are frequently most marked just below the neck of the sac, especially if a truss has been worn this part becoming densely adherent to the tissues about it and often developing into an almost fibro-cartilaginous ring, while the true neck and the structures composing the inguinal or femoral canal become thinned out and matted together owing to the pressure of the truss. In such cases the omentum in the sac is often adherent to the entire circumference of the neck.

3. **Cartilaginous and calcareous degeneration**—These are only met with in hernial sacs of large dimensions and long standing The areas of degeneration are usually discrete, and seldom involve the entire sac wall.

4. **Obliteration of the neck.**—Occasionally a sac containing fluid is seen in which the original communication with the abdominal cavity has been cut off. The cause is to be sought in some antecedent inflammation at the neck of the sac by which the passage has been sealed The pressure of a truss on a strand of unreduced omentum may be the cause occasionally the obliteration appears to be spontaneous, no truss having been worn. Such a fortunate result is only possible in sacs having very narrow necks the condition is termed hydrocele of a hernial sac."

5 **Cysts in hernial sacs**—In certain cases a hernial sac will be found to include one or more cysts containing fluid giving the impression of a second sac within the first. These cysts will be found to have no connexion with the abdominal cavity or the tunica vaginalis. They are developed in or between the sac walls and its coverings. They are commonly due to lymphatic dilatation or to subserous effusions resulting from irritation or injury and have no pathological importance.

6 Acute inflammation.—This is rarely seen except in the sacs of very large irreducible hernias. It is of the nature of a localized peritonitis, is predisposed to by direct injury and usually results in resolution with the formation of extensive adhesions between the sac and its contents. At times it may give rise to strangulation of these contents or may progress to complete sloughing or gangrene. It is especially prone to occur in the victims of Bright's disease, in whom the prognosis is consequently very unfavourable.

7 Loculation.—Although due at times to congenital abnormality the formation of secondary loculi in hernial sacs is also seen as the result of inflammation about the inguinal and femoral regions, and is an almost constant feature of umbilical hernias of any size. It is especially prone to occur in recurrent hernias of rapid formation. The presence of omentum densely adherent to the sac wall below the neck may compel the wall above the adhesion to bulge laterally through the separated fibres of its coverings. Thus the original sac may have one or more secondary loculi, opening usually near the neck, and often as large as or even larger than, the parent sac.

8 Localized disease.—Although extremely rare cases have been reported of the presence of disease apparently confined to hernial sacs. I have met with three such cases in two elderly men masses in the fundi of the sacs proved on section to be spheroidal-celled carcinomas in the third a middle-aged man an apparently localized tuberculous mass was found.

Secondary changes in the coverings.—In some cases the coverings, owing to very rapid increase in the size of the hernia, become extremely thin, their fibres being widely separated and atrophic the common condition in umbilical hernia on the other hand, those which develop slowly and steadily frequently undergo marked hypertrophy the muscular coverings especially appearing as a definite thick layer In such cases the blood supply is markedly increased, and large vessels are seen ramifying over the surface of the sac, while the coverings are matted together and often densely adherent.

Occasionally in very large umbilical and ventral hernias, whose coverings are atrophic the skin at the most dependent part becomes œdematous and inflamed, and a slough appears, or what is more common, a recurrent superficial ulcer Such changes are due to interference with the blood supply and to the influence of gravity

Secondary changes in the contents.—As regards the omentum the most noteworthy changes are the remarkable and often rapid increase which takes place in its volume when it remains permanently in the sac and its proneness to become adherent to its surroundings. This increase is independent of any general increase

in obesity of the patient, and depends chiefly on interference with the venous return from the omentum, since the most marked examples are met with where this organ is adherent to the neck of the sac at the same time it is not entirely due to œdema, distension of vessels, nor to intrusion of fresh omentum but in part arises from actual hypertrophy

Adhesions in hernial sacs may concern—

1 *The sac only*—Fibrous bands the result of old inflammation, are at times found passing from one side to the other these may subsequently become stretched and form bridles," just as they do in the abdominal cavity Their only surgical importance is that they predispose to strangulation, and especially if they cross the neck, are apt to ensnare a loop of bowel when reduction is attempted, thus giving rise to one of the varieties of "reduction *en masse*" (p 657) They may occur simply as elevated *cicatricial bands* on the inner surface. Again, an actual septum may be produced by these adhesions, the sac being thus divided into an upper and a lower compartment, the latter of which, filling with fluid, becomes a hydrocele of the sac.

2. *The sac wall and the contents*—When adhesions occur between these two they commonly result from inflammation of the omentum. Bowel is rarely found adherent to the sac unless affected by inflammation arising in the omentum, or unless itself diseased. Thus a loop of bowel containing tuberculous ulcers, an appendix when inflamed, or a portion of large bowel inflamed as the result of stercoral ulceration, may acquire adhesions to the sac at any point. Similarly the ovary and Fallopian tube may become adherent to the wall.

3. *The contents alone.*—Rarely adhesions occur in the sac without affecting its walls. The contents may be so bound together as to prevent reduction, the cause being, as before, the presence of inflamed omentum, etc.

The **intestine** when long retained in a sac by adhesions, frequently undergoes marked hypertrophy In certain cases owing to some constriction at the neck of the sac not sufficient to cause actual strangulation it may become permanently narrowed at one or more points by a ring-like atrophy of the muscular wall and subsequent fibrosis at these points.

In umbilical and ventral hernias the bowel may become adherent to the thinned-out cutaneo-peritoneal sac and may then be affected by the sloughing above mentioned, a fæcal or intestinal fistula resulting

Occasionally an **appendix** or an **ovary** occupying a hernial sac undergoes an attack of acute inflammation and, if the presence of

these organs has not been diagnosed, the case may be treated simply as one of inflamed sac, with the result that an abscess forms, and in the one case a fæcal fistula, and in the other sloughing of the ovary and its tube, is the result.

Etiology of hernia.—It has been customary hitherto to divide all hernias into two classes viz. (1) those dependent on some arrest in the development of the abdominal wall at or previous to birth and therefore known as *congenital* and (2) those which owing to weakening of the abdominal wall at its most vulnerable points by subsequent strains and injuries, originate in later life, and are known therefore as *acquired* Much doubt has been thrown on the accuracy of the latter term by Hamilton Russell, whose theory is dealt with later (p 606)

Whether a hernia be congenital or acquired certain factors are essential to its formation—(1) a weak spot in the abdominal wall, and (2) an increase in the intra-abdominal pressure

1 **Weak spots in the abdominal wall** —Inasmuch as fibrous tissue lacks the power of resistance to strain and of recovery after stretching possessed by muscle, all areas in the abdominal wall that depend for their strength upon either aponeuroses or cicatrices are to be considered as weak spots.

If the entire abdominal wall were guarded by muscular tissue alone hernia would probably be comparatively rare The naturally weak points of the abdominal wall are as follows The inguinal canal the femoral canal the umbilicus the median line of the abdomen the lumbar (Petit's) triangle the obturator foramen the sciatic notch the intermuscular spaces in the levator ani and the costo-xiphoid interspace.

2. **Increase of intra-abdominal pressure.**—This is probably only a potent factor—(i) When it is *quickly developed* as in rapid ascites or in general obesity (ii) When it is *sudden, powerful, or intermittent*, as in heavy manual labour in the playing of wind instruments, in coughing or screaming, in repeated pregnancies in weakly women, or in the straining necessitated by phimosis, stricture constipation etc (iii) *When gradual pressure is suddenly relieved and followed by intermittent increase* e.g when large old-standing pelvic tumours are removed in asthmatic or bronchitic patients. Gradual increase alone has probably but little influence

Defæcation and hernia.—Although the squatting position during defæcation is both natural and anatomically and physiologically correct most modern conveniences demand a sitting posture in which the groins are undefended, the abdominal muscles lack a *point d'appui*, and consequently the effort required is a serious tax on the weak spots. If the effort to support the abdomen on the thighs is made

pain, tenderness in the hernia, distension of the abdomen and perhaps the presence of peristaltic waves. Such signs are an indication for early operation.

Anatomical Varieties of Hernia

Of the weak spots of the abdominal wall at which hernias may appear the *inguinal canal* is by far the most frequently involved here two varieties of hernia are met with, viz. *oblique* and *direct*.

Oblique inguinal hernia (Fig 450)—This form of hernia makes its exit at the internal abdominal ring, and passing along



Fig 450—Oblique inguinal hernia becoming inguino-scrotal also early umbilical hernia.

the spermatic cord in the male, or the round ligament of the uterus in the female leaves the canal at the external abdominal ring, and enters in the former case the scrotum (Fig. 451) and in the latter the labium majus The neck of the sac thus has the deep epigastric artery as *its immediate internal relation*.

An oblique inguinal hernia is invariably clothed by certain structures known as its coverings these are best described in order of dissection thus (1) skin (2) superficial fascia (3) aponeurosis of the external oblique muscle and its arciform or intercolumnar fibres, commonly called the "external spermatic fascia" (4) cremasteric fascia, which is simply the stretched fibres of the cremaster muscle (5) "internal spermatic fascia or infundibuliform fascia a finger like

process of the transversalis fascia and (6) the extraperitoneal fascia which overlies the peritoneum These coverings, with the exception of the cremaster which is often hypertrophied in old-standing cases, are not as a rule easily demonstrable being usually fused together

In large hernias which have existed for many years the internal ring often becomes so much distended that its inner edge is shifted inwards similarly when the hernia is of the scrotal variety the outer edge of the external ring becomes displaced outwards, so that in time the two rings are found to be superimposed, and several fingers, or even the whole hand, may be passed into the abdomen the oblique character of the hernia being then apparently lost. The relative position of the deep epigastric artery however will always show the true nature of the hernia the position of the structures of the spermatic cord will also help to distinguish it, for although in large hernias they may be much separated by pressure, they will still lie *deep to the sac.*



Fig 451 —Sac of ordinary inguinal hernia.

H.S., Hernial sac; T., tunica vaginalis; O., pubes; R., rectus muscle

Associated with the hernia there is often a marked weakening of the whole inguinal region, permitting of much bulging when the patient stands up or strains, and this is especially common where the hernia is bilateral It may be due in elderly subjects with large hernias, to the presence of the hernia itself, but in young subjects it is often congenital, and will be found to be caused by a high origin of the internal oblique muscle and a defect in its development. Such inguinal weakening may follow damage to the lowest dorsal nerves during an operation upon the appendix.

The progress of an inguinal hernia may be comparatively slow till it reaches the external abdominal ring, from which time the force of gravity favours its descent, and it rapidly enlarges, becoming "inguino-scrotal" (Fig 450) or "inguino-labial according to the sex of the patient. Where however the sac is that which has been described as congenital vaginal" or congenital funicular" the development of the hernia is in some cases actually immediate, the swelling appearing suddenly on some unusual expiratory effort.

On arriving at the scrotum, many of these hernias especially in elderly subjects, attain an enormous size and cause great discomfort

owing to their weight and to the fact that the penis is frequently retracted into the mass so as to disappear out of sight, micturition being thus rendered difficult Such hernias are usually quite irreducible, frequently become incarcerated but are seldom strangulated, owing to the width of the neck of the sac The skin over such scrotal hernias is frequently eczematous, excoriated, or even sloughy owing to the dribbling of urine during micturition.

Direct inguinal hernia.—In this variety the hernia in place of making its exit by the internal abdominal ring, leaves the abdomen *internally to the deep epigastric artery* It thus enters the inguinal canal through its posterior wall carrying the stretched fibres of the conjoined tendon of the internal oblique and transversalis muscles with it. It then takes the same course as the oblique variety passing into the scrotum or labium through the external abdominal ring It is probably the only variety of hernia which can truly be said to be acquired, and even in some cases it, too is possibly congenital in origin. The coverings of direct hernia are exactly similar to those of oblique, except that the cremasteric fascia of the latter is replaced by the conjoined tendon in the former and that the term "infundibuliform" is not usually applied to the transversalis fascia here The sac lies *posteriorly* to the spermatic cord which it often separates widely by pressure.

The following characters of direct hernia differentiate it from oblique hernia It occurs at a later period of life. It is slower in its development, less frequently becomes scrotal, and more often rises towards the pubic region The neck of the sac is wide and the hernia is often a mere bulging It is much less liable to strangulation, and is as a rule reducible. It more often contains small bowel, and not infrequently a portion of the bladder It much more frequently results in a very large gap in the abdominal wall. It is more commonly bilateral In thin subjects it is at times possible, with the finger in the ring, to feel the pulsation of the deep epigastric artery along the *outer* edge of the neck of the sac

Symptoms and diagnosis of inguinal hernia.—In most cases subjective symptoms are absent and a swelling is accidentally found. Occasionally there is a feeling of dragging in the loin of that side, or actual shooting pain caused by the stretching of the fascial planes this may be accompanied by nausea or actual retching, a small piece of omentum or a knuckle of bowel being nipped during sudden flexion of the thigh There is also a sense of weakness and insecurity in the groin on coughing, which, even in patients ignorant of the presence or nature of a hernia, prompts them to support it by manual pressure.

When the hernia has reached the length of producing an obvious swelling in the groin and is reducible, the diagnosis is simple thus, the reduction, on applying pressure, is rapid, and often accompanied by a gurgling sound if bowel be present if the tips of the fingers be placed over the external abdominal ring, and the patient be directed to cough a distinct impulse will be felt, which will be still more obvious if the little finger be passed gently into the ring by invaginating before its tip the skin of the scrotum By careful palpation the swelling will be found to be *above the level of Poupart's ligament* and, if it has reached the external abdominal ring *internally to the spine of the pubes* The empty sac may also be felt as a thickening in the course of the cord.

Where the hernia is confined to the inguinal canal (i.e. a "bubonocele) and is *irreducible*, there is more difficulty it is then necessary to differentiate between hernia and the following inguinal swellings —

(*a*) *Encysted hydrocele of the spermatic cord or of the canal of Nuck.* —This is firm, elastic, usually of small size dull to percussion, fixed in position, and not usually tender Using a small transillumination lamp the swelling will be found to be translucent the intestine in infants, however is also translucent.

(*b*) *Retained testis* —Testes retained in the inguinal canal are practically always mobile they retain their characteristic sensation of tenderness to pressure and are nearly always in association with an unobliterated processus vaginalis. The testis is absent from the scrotum.

(*c*) A *lipoma of the spermatic cord* is softer more lobulated and quite devoid of tenderness.

(*d*) A *fibroma of the inguinal canal* begins at the *inner end* of the canal, arising as a rule from the sheath of the rectus abdominis muscle, and is very fixed and hard it is painless, of slow growth, and of rare occurrence.

(*e*) *Glandular swellings* may be recognized by their marked lobulation association with other such swellings, rapid increase in size, and tendency to break down and by the rarity with which single glands are affected here

(*f*) For the differentiation from *femoral hernia* see p 614

When the hernia is scrotal, the diagnosis is again easy except in some cases of old-standing hydrocele of the vaginal process, in which reduction of the fluid is accomplished only gradually and the walls are too thick to allow of translucency The following points will help The mass is dull to percussion this means either fluid omentum or incarceration Fluid gives a smooth tense heavy tumour which in this case will reduce very slowly and as slowly return, and which will often give a characteristic "thrill to one hand when

flicked smartly by the finger of the other Omentum is rarely reducible in large hernias is always lobulated and seldom tense. Incarceration produces constitutional disturbance and has the characters already described (see p 607)

At times it may be difficult to diagnose the presence of a hydrocele of the tunica vaginalis when in association with an irreducible omental scrotal hernia, if both are of long standing There is, however generally a slight constriction to be felt between the two but the question is not one of much practical importance. Such a case is shown in Fig 461 p 636

From hydrocele of a hernial sac, or from a large vaginal hydrocele, a hernia may be diagnosed by the fact that in the former conditions the swelling is localised to the lower two-thirds of the scrotum is tense, elastic heavy painless dull to percussion, devoid of tenderness often translucent, and by the cord being distinctly felt for a space between the upper end of the swelling and the external abdominal ring

Femoral hernia.—All structures which leave the abdomen to pass into the limbs or abdominal wall carry with them for a short space an investment from the transversalis fascia which lines the abdomen, and which is gradually lost on their surface. In the case of the femoral vessels this investment, known as the "crural or femoral sheath," is well marked and is constituted by a downward prolongation of the transversalis fascia in front and the iliacus fascia behind. It forms a funnel-shaped passage which is subdivided into three compartments by two fascial partitions. The outer of these contains the femoral artery the middle contains the femoral vein, and the inner which is known as the femoral or crural canal is unoccupied save for a lymphatic gland and a small plug of extraperitoneal fat. It is along this inner canal that the contents of a femoral or crural hernia descend. Its mouth is known as the crural ring"

The anterior wall of the canal formed by transversalis fascia is covered by the falciform ligament" derived from the iliac portion of the fascia lata, whilst behind the posterior wall (formed of iliacus fascia) passes the pubic portion of the fascia lata. The outer wall is the septum between the canal and the femoral vein, whilst to the inner side of the inner wall lies Gimbernat s ligament above and the pectineus muscle below (internally and posteriorly) Overlying the lower end of the canal is the saphenous opening" in the fascia lata of the thigh this is closed by the cribriform fascia which transmits some lymphatics and veins. The "crural ring is closed by a thick mass of areolar and often fatty tissue the septum crurale. The immediate relations of this ring are as follows —

Internally Gimbernat s ligament, the little, sharp-edged, triangular

band of fascia which fills in the pubic angle between the inner end of Poupart's ligament and the horizontal ramus of the pubes. *Externally* The femoral vein. *Anteriorly* Poupart's ligament. *Posteriorly* The horizontal ramus of the pubes.

In the course of its descent, a femoral hernia, leaving the abdomen through the crural ring, passes down to the bottom of the crural canal, and taking the line of least resistance, passes forwards through the saphenous "opening" and appears as a swelling in the groin. In its passage, therefore, it acquires *the following coverings*, which are given in order of dissection, viz. (*a*) skin (*b*) superficial fascia (*c*) cribriform fascia (*d*) crural sheath (*e*) septum crurale (*f*) extra peritoneal fascia (*g*) sac of the hernia.

If Hamilton Russell's theory be accepted, the sac of a femoral hernia is always of congenital origin, and may occupy one of three positions this is due to the fact that the peritoneal process from which it is formed is, in the course of the growth of the limb-bud in the embryo drawn out from the abdomen along the line of the vessels proceeding from the femoral artery Thus at times the sac will be found passing inwards along the course of the external pudic, upwards along that of the superficial epigastric, or outwards following the superficial circumflex iliac artery A compromise between the latter two positions is the more common, the sac passing out of the saphenous opening and then turning upwards and outwards to a position between the two latter vessels. At times more than one sac may be present this is said to be one of the chief causes of the recurrence of femoral hernia after operation, one of the sacs being overlooked at the time.

Another explanation of the course taken by a femoral hernia after leaving the saphenous opening (viz. upwards and outwards) is that, the falciform edge of fascia being the most resistant margin of the saphenous opening, more friction occurs there, and the escaping hernia therefore turns at right angles to that structure.

As regards frequency femoral hernia is much more common in women than in men in the proportion of 5 to 1 It is, however less common in women than inguinal hernia and is usually met with at a rather more advanced age. The presence of a femoral hernia, owing to the depth of its origin, the receding angle of the groin, and the fact that it is rarely of large size is frequently overlooked, and in stout patients its diagnosis is not always easy Its characteristic features are these It is nearly always irreducible from the first the neck is always very narrow omentum is its usual content, bowel being rarely found in it except when strangulation reveals its presence owing to the narrowness of the neck, strangulation is frequent and rapidly leads to gangrene the chief element of danger being found in the presence of the resistant, knife-like edge of Gimbernat's ligament.

Diagnosis of femoral hernia. — 1 The resemblance of a femoral to an *inguinal hernia* may at times be very close on casual inspection the distinction, however depends on the relationship of the neck of the sac to the spine of the pubis. On careful palpation, the spine will be found to lie externally to and below the neck of an inguinal, and above and internally to that of a femoral sac but, as the latter *frequently passes upwards and overlies* the inner third of Poupart's ligament and becomes to some extent fixed there, careful examination is at times required to differentiate these hernias. The femoral variety is most closely simulated by the inguinal bubonocele, but in the latter case reduction is effected by pressure directed backwards and outwards, whereas in the former the direction of pressure must be downwards very commonly the hernia is not capable of reduction at all. Again, an irreducible bubonocele cannot be moved in any direction while a femoral hernia is often capable of being pushed downwards or laterally On attempting to pull a femoral hernia upwards over Poupart's ligament it will be found to have a firm anchorage at the saphenous opening, and the neck of the sac will be distinctly felt if the tips of the fingers are placed just over the opening and moved to and fro across it like the teeth of a saw

2. *Enlarged femoral glands* are generally distinguished by being (*a*) firmer and more lobulated (*b*) often discrete (*c*) commonly bilateral and in association with other glandular enlargements (*d*) if not bilateral often dependent upon inflammatory conditions of the lower extremity (*e*) not accompanied by dragging sensations in the groin or loin (*f*) often movable in *any* direction or if fixed lacking the definite neck above-mentioned (*g*) prone to a rapid enlargement, which is accompanied by signs of softening At the same time they may coexist with a hernia, and in stout patients are often impossible to differentiate from that condition.

3. *Saphena varix is easily distinguished by its cystic character*, and by the fact that it can be readily emptied by pressure, and by compression of the vein below the swelling refilling at once on the release of pressure even when the patient is in the supine position (when fluctuation can often be felt between vein and swelling) It is, further almost always part of a general varicosity of the saphena vein.

4. *Aneurysm of the femoral artery* exhibits the characteristic expansile pulsation which can be arrested by pressure on the external iliac artery when the swelling will be in part at least, reduced without gurgling It is, like saphena varix, cystic in character and the swelling reappears on the release of pressure. The stethoscope will reveal the usual bruit of an aneurysm It is important to recognize the *expansile*

character of the impulse here, since tumours overlying the vessel (e.g. an omental hernia, or a mass of glands) may receive transmitted pulsation from it.

5. A *psoas abscess* when presenting beneath Poupart's ligament, produces a swelling which, although appearing externally to the vessels, occupies much the same position and gives the same impulse on coughing as a femoral hernia. It lacks, however the neck, is cystic in character is commonly associated with some tenderness or kyphosis of the lumbar spine may be accompanied by wasting, and fluctuation can often be made out between the femoral swelling and that in the iliac fossa.

The most *important points* to remember with regard to femoral hernia are its liability to early strangulation the danger of early ulceration of bowel when strangulated the close relationship to the bladder on the inner (a diverticulum from the latter often projecting into the sac) and to the femoral vein on the outer side the possible presence of the aberrant branch of the obturator artery which may pass along the inner aspect of the neck of the sac, and be in danger of division during the operation of kelotomy (*see* Strangulated Hernia p 652)

The contents of a femoral are, for all practical purposes, the same as those of an inguinal hernia, except that large intestine is less frequently and the urinary bladder more frequently met with.[1]

Umbilical hernia.—Except when congenital in origin, this form of hernia is rarely seen before middle life, and is much commoner after than before 40 Like femoral hernia, it is almost confined to the female sex, and especially to women who have borne many children and have become obese

Umbilical hernia is especially characterised by—(1) Its extremely progressive tendency Unlike the forms already mentioned there is almost no limit to the size which it may attain, and sacs are occasionally met with containing more than half the intestinal contents of the abdomen. (2) The tendency to widespread loculation of the sac. (3) The extensive and rapid formation of adhesions, leading to (4) early irreducibility (5) The proneness to and dangerous nature of strangulation here (6) The difficulty of accomplishing a radical cure

Causes of umbilical hernia.—It is doubtful if, when this hernia occurs in later life, its sac is ever "preformed" it is probably the result of stretching of the umbilical cicatrix by a gradual increase of intra-abdominal pressure or by the long-continued inter

[1] Brunner's and Maydl's statistics would seem to show a greater frequency of the bladder in *(sex sal* hernias; the bladder is more often seen as a simple bulging in inguinal hernia but as a true diverticulum projecting into the sac it is commoner in femoral hernia.

mittent increase of such pressure. Thus it is most commonly seen as the result of repeated pregnancy general obesity in women about the menopause, accumulation of ascitic fluid or the repeated strain thrown on the abdominal wall by the constant coughing of chronic bronchitis and emphysema.

Clinical features of umbilical hernia.—At first there may be *nothing seen externally* and the patient's attention may be drawn to the trouble owing to dragging pain at the umbilicus, often accompanied by nausea and flatulent distension of the abdomen. There may be tenderness in the umbilical region, and frequently the symptoms are increased by the act of lying down, owing to dragging upon omentum that may happen to be adherent in the hernia. Where such a "blind hernia" is present, it may in a very stout patient become strangulated without the external evidence of a swelling to assist the diagnosis. Owing to the thickness and the loose character of the subcutaneous and extra peritoneal fat layers, the expansion of the hernial contents causes the sac to bulge in various directions along the lines of least resistance into either or both of these layers (but especially into the former) The result is that in small hernias the swelling is hidden in the fat, while in large ones there is produced a two-storied and complicated arrangement of secondary sacculi, radiating from the central passage which represents the original sac (Fig 452) If then the hernia commences by the protrusion of a lateral sacculus into the extraperitoneal, or into the deep portion of the subcutaneous layer a "blind hernia" is produced (Fig 453)

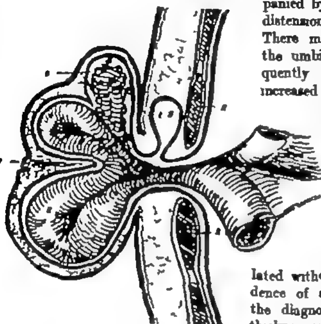


Fig 452.—Umbilical hernia showing sacculation in superficial fascia (transverse section)

a, Lateral sacculus; bowel c, omentum rectus muscle e, umbilicus.

More commonly there will be noticed at the umbilicus a slight protrusion which transmits an impulse on coughing. In the early

stages, at least it can always be easily reduced and the sharp edges of the ring can then be felt.

At a later period these hernias may assume gigantic proportions spreading out on either side of the abdomen in an ill-defined and lobulated mass or projecting directly forwards, with a tendency by their own weight to sink down and overhang the pubes (Fig 451)

At an early stage the sac becomes adherent to the coverings—peritoneum, aponeuroses, and skin being welded into one layer later as distension increases, these coverings become thinned out, so that the intestinal movements may be observed through them. At the same time extensive adhesions are formed between the contents themselves (the omentum being chiefly involved) and the sac walls In very large pendulous hernias the skin at the most dependent part is often reddened, chronically inflamed and œdematous, and sometimes shows desquamation or ulceration whilst a broad band of intertrigo appears at the lower edge of the hernial neck. Fæcal fistulæ may result from such ulceration opening into bowel in the sac

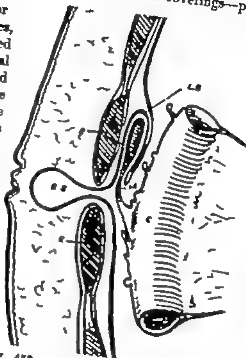


Fig 451.—Blind hernia of umbilicus appendix epiploica occupying lateral sacculus (transverse section)

B.S., Blind sac; L.S., lateral sacculus; A., appendix epiploica; C., colon; R., rectus muscle.

The contents of these hernias are usually omentum and transverse colon, but small intestine is common, and stomach may be encountered. Reduction is seldom possible in longstanding cases, owing to the sacculation already mentioned and when strangulation occurs the prognosis is bad owing to the obesity of the patient and the pulmonary complications frequently associated with it.

The discomfort induced by a large umbilical hernia may be very great apart from the constant drag on the abdominal contents, the weight to be supported, the interference with clothing and the unsightliness of the patient's figure there is constant liability to attacks of colic nauses constipation or actual incarceration of the hernia

Little can be done to relieve these troubles except by operation (Fig 455) and the risk of this is, in very stout patients, considerable.

Congenital umbilical hernia.—It is customary to apply




Fig. 454.—Large umbilical hernia, before operation (*Same case as in Fig 455*). Front and side views.




Fig 455.—Large umbilical hernia cured by implantation of filigree measuring 9 in × 5 in. (*Author's case*) Front and side views.

this term to hernia at the navel in infants and young children when it occurs in the first few months of life Two forms of it are described In one there is intestine present in the umbilical cord at birth *retraction not yet having taken place* Here the umbilicus is represented by a

circular gap, the spread-out membranes of the cord covering the loop of intestine and fusing with the skin at the margins of the gap. In such a case these avascular amniotic membranes may become gangrenous or may rupture leaving a factitious ectopia of the viscera; in most cases of this kind death results from septic peritonitis. If the membranes retain their integrity sufficiently long to permit of the retraction of the bowel the aperture may close, but the cicatrix being weak a hernia may develop at the site of closure at a later date. In the other form of this hernia there is complete retraction of the bowel at the time of birth, but the sound *closure of the aperture* is *delayed*. In such cases there will be a bulging of the degenerate skin at the umbilicus on any expiratory effort, and subsequently from lack of proper treatment a moderately large hernia may develop. To this variety the term "infantile" may be applied.

Although these hernias, when correctly treated, rarely give rise to serious trouble during infancy or adolescence, they do at times become strangulated. In any case the cicatrix of a "delayed closure" is never so perfect as that of the normal umbilicus; a small peritoneal dimple, which must be regarded as a predisposing factor in the umbilical hernia of later life, frequently remains to mark the site on the visceral surface of the parietes.

Ventral hernia.—This may be spontaneous or acquired, the latter being very much the commoner. Apart from umbilical hernia, which is only a special form of ventral hernia, protrusions of viscera may occur in the middle line above that point (median epigastric hernia) or below it (median hypogastric hernia), or may occupy the entire length of the linea alba (complete median hernia). They may also occur at other points in the abdominal wall, but in this case they are invariably traumatic and are known as "lateral ventral hernias."

Spontaneous hernia (median) is rarely seen except in association with large umbilical hernias, where it is usually an extension downwards of the rupture, the lower segment of the umbilical ring having given way and the recti muscles having become separated. Above the umbilicus it is more often separate, and is sufficiently rare to suggest the possibility of a congenital origin; and this is supported by the fact that it is not usually seen in stout patients, and is not, therefore, the direct result of distension. It is perhaps less rare in men than in women. The presence of *subperitoneal lipomas* has been noted in many instances, and is found to be a causative factor in some cases of ventral hernia, more especially of the median epigastric variety. In insinuating themselves into some slight deficiency in the transversalis fascia or the fascia of the posterior sheath of the rectus muscle these small tumours gradually expand the cavity which they have invaded, and by their traction at times draw after them the process of

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peritoneum to which they are attached. Thus a true hernial sac is formed. These hernias are also found occasionally in the linea semilunaris, and many femoral hernias probably owe their origin to the presence of the lipomatous material in the crural canal.

Complete median hernia results from wide separation, or *divarication*, of the recti muscles, and is more frequently seen in thin women who have borne many children than in those who are markedly obese; it is also seen in elderly men of feeble muscular development who have been subjected to hard manual labour. Although rarely sufficiently marked to require operative interference, it is none the less in the nature of a hernia, and may result in considerable weakness and bodily discomfort. It extends usually from the ensiform cartilage to the pubes, the actual extent being easily ascertained by making the patient raise the head and shoulders from the supine position without the support of the hands. The hernia will at once show as an elevated ridge along the linea alba, the actual gap being felt by passing the ulnar edge of the hand into it.

It is probable that this condition originates in a congenital wideness of the linea alba, and is only aggravated by subsequent exertion, as many young subjects are met with who exhibit wide separation without actual hernia. Adhesions, irreducibility and strangulation are never met with in this form of hernia, although they occur in the epigastric variety.

Hernia through scar tissue.—Space does not permit of a discussion of the pathology of these hernias, but the following points should be noted:—

Hernia never occurs through the *muscular wall* of the abdomen except as the result of its conversion at some point into scar tissue.

This may occur as the result of suppuration or ulceration, transverse division of the muscular fibres with subsequent stretched union, destruction by disease, or extensive division of the nerves supplying the muscles.

The whole thickness of the abdominal wall being converted into scar tissue, there is no true sac; all the layers are welded together and the contents are invariably adherent, often densely so.

Owing to the alteration in structure of the muscle-fibres, and to the fact that only by the primary union of healthy muscle can such a hernia be prevented from recurring, these hernias are sometimes difficult to cure, and may necessitate extensive plastic operations.

Where approximation of the above nature cannot be accomplished, recurrence can be prevented by converting the distensible cicatrix into material which cannot stretch, e.g. by the use of silver filigrees.

The period requisite for the formation of a fully organized

cicatrix produced by a primary union is probably not less than forty to sixty days.

Such a hernia may follow the cicatricial weakening of any part of the abdominal wall either by accident, by disease, or by inadequacy of suturing of operative wounds—whether due to faulty technique or to the character of the operation as in drainage of abscesses or of the gall bladder

However produced traumatic ventral hernia is, like umbilical hernia, constantly progressive, crippling to the patient, and often difficult to repair it is not amenable, as a rule, to any form of truss or belt. In spite of the extensive adhesions found in the sac strangulation is very seldom seen.

Lumbar hernia.—A hernia appearing through the lateral aspect of the abdomen—that is, between the iliac crest and the last rib—is known as lumbar It is by no means common, and much doubt exists as to the etiology of those cases which are not definitely traumatic In some cases it is apparently congenital, depending on defects in the musculature, or on deficiency of the last rib in others it follows the development of abscesses arising in the muscular wall or in connexion with caries of the twelfth rib the commonest form, however is that which follows stretching of the scar resulting from operations upon the kidneys, especially where prolonged drainage has been employed The congenital form may appear in two different situations, viz. (*a*) behind the posterior axillary line and just beneath the last rib and (*b*) anteriorly to that line and immediately above the crest of the ilium. The upper of these hernial sites is the less common of the two it is the position frequently occupied by a lumbar abscess and from this it must be diagnosed, since both hernia and abscess are elastic, reducible to some extent, and give an impulse on coughing.

The lower hernial site is that which is known as Petit's triangle" it is bounded below by the crest of the ilium in front by the posterior margin of the external oblique muscle, and behind by the anterior margin of the latissimus dorsi muscle. The hernia is rarely more than a slight bulging, and only when there is a distinct deficiency in the extent of origin of these muscles can the triangle be said to exist. Where hernia follows operations upon the kidneys the bulging will occupy the whole space between the ilium and the last rib. Owing to the transverse division of the muscle fibres in these operations, the difficulty of approximation, and the frequent necessity for drainage this hernia, when it occurs, is extensive and very disabling.

Of whatever variety lumbar hernia rarely contains anything but omentum and ascending or descending colon the sac resembles that of other ventral hernias, being ultimately incorporated with the

ticulum into another; and in the occurrence of strangulation in these diverticula. The intimate union of the transversalis with the internal oblique muscle renders the occurrence of a diverticulum between these muscles very rare, although such cases have been recorded. Interstitial hernia has been attributed to forcible and oft-repeated clumsy efforts at reduction. This is a mistaken theory; such attempts could only lead, where no diverticulum is present, to displacement of the *whole* sac, or rupture of its neck. These cases come under the heading of "Reduction *en masse*" (p. 657) and are not true interstitial hernias. The danger of strangulation in interstitial hernias is considerable, and only occasionally is their presence diagnosed before operation. Some bulging of the abdominal wall above and outside the internal abdominal ring may be noticed, or it may be possible to feel the diverticulum fill up on reduction being effected from the scrotum; this latter being then kept empty, the diverticulum may be detected by gurgling, or sudden emptying, on reduction of its contents being effected.

The abnormalities which have been noted in association with these hernias are—(1) Retention, maldevelopment, and ectopia of the testis. (2) Absence of the cremaster muscle. (3) Superimposition of the abdominal rings. (4) Partial obliteration of the external abdominal ring.

Umbilical hernia is so constantly associated with diverticulation of the sac that it cannot be considered as an irregular hernia, nor as interstitial, although the diverticula are at times found both between the peritoneum and the posterior sheath of the rectus muscle, and between the anterior sheath and the superficial fascia.

Traumatic interstitial hernia.—This is the result of ruptures or pathological lesions of the abdominal wall in which only the deeper layers have been affected; it is consequently a very rare condition. It has been seen following rupture of a section of the rectus muscle. Such a case occurred in my own practice; the bowel was found between the muscle and its anterior sheath, the rupture having taken place between the two lower lineæ transversæ on the left side. Deep-seated gummata or chronic abscesses which have resolved under treatment may result in the formation of such a hernia. But however they are produced they can remain interstitial only for a time; in the course of years the coverings become thinned out, fused together, and amalgamated with the sac, and their interstitial character is thus to a great extent lost.

The diagnosis is not usually difficult; an elastic, hyper-resonant swelling, exhibiting intestinal gurgling, in the substance of the abdominal wall can hardly be mistaken for anything else than hernia. If the sac contains only omentum the case is not so obvious, for impulse being probably absent owing to adhesions, the lobulation

and doughiness of the mass might suggest a lipoma or other form of tumour

Partial enterocele (Richter's hernia).—Occasionally a portion only of the lateral wall of the bowel may protrude through a hernial ring, or through some adventitious opening (Fig 458) The ileum is the part most commonly affected, and though the site of the hernia may be very various the condition is most often seen at the femoral ring. A comparatively rare form of hernia, it is said to be more frequent in women than in men, and in adults than in children. The hernia is always small in size, being rarely larger than a marble and the ring wherever it may be, is always narrow thus strangulation is commonly the first evidence of the trouble. Its chief importance lies in the fact that *the strangulation fails to give rise to two of its cardinal signs* viz. complete obstruction and fæcal vomiting The entire lumen of the bowel not being involved in the ring, flatus and fæces may continue to pass from time to time, and consequently fæcal vomiting may be absent. Therefore gangrene of the constricted portion may easily supervene before a diagnosis is reached. Reduction is rarely possible, and even when it is accomplished by operation, the constricted neck, which is on the antimesenteric aspect of the bowel, may be permanently altered by the development of cicatricial tissue in its wall with the result that the herniated portion remains as a permanent diverticulum.

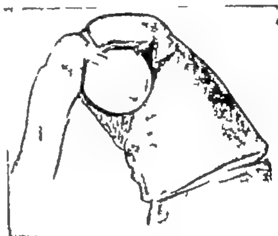


Fig 458.—Richter's hernia.

(From Gould and Warren "International Text Book of Surgery")

The hernia is rarely diagnosed the mortality is consequently high (60–65 per cent.) even when operation is undertaken. In some cases, however gangrene has supervened and a spontaneous recovery has resulted leaving the patient with a fæcal fistula into the scrotum or at the groin or umbilicus

Hernia of Meckel's diverticulum (Littre's hernia).—Although only differing from the last mentioned variety in its embryonic origin, this hernia must be mentioned separately since the lateral

diverticulum in this case exists prior to the hernia and is not the result of it.

Meckel's diverticulum, the unobliterated remains of the vitello-intestinal duct, when present, springs from the antimesenteric aspect of the ileum usually within 3 ft of the ileo-cæcal valve, and is generally attached by a terminal narrow band to the umbilical site. Strictly speaking, therefore, it should be associated with umbilical hernia. Since, however it may be found in the sacs of other hernias it is given a special place, and the term has been loosely applied to any hernia in which the diverticulum is involved The diverticulum varies from a mere prominence on the surface of the bowel to a tube 3 to 5 in. in length with at times, a diameter almost as great as the bowel from which it springs. Its strangulation therefore produces symptoms and results exactly similar to those of Richter's hernia, with the exception that when the diverticulum is well developed the operative treatment is simplified and the mortality is lessened.

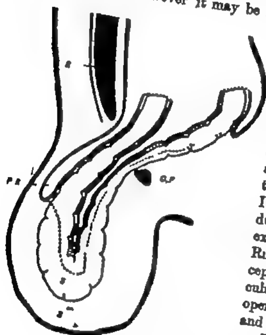


Fig. 459 —Extraperitoneal hernia of sigmoid.

Pubes [illegible] rectus muscle; [illegible] peritoneal reflection [illegible] sigmoid colon [illegible] scrotum.

Hernia in the absence of a sac.—Although it is hardly accurate to say that a hernia may occur without a sac, certain protrusions of viscera do occur uncovered or only partially covered by parietal peritoneum. In these cases a sac either has disappeared by an alteration in the position of the hernia, or can be found lying to one side of the main mass of the protrusion. Such instances are to be found in hernias of the cæcum sigmoid, and bladder

Hernias of the cæcum and sigmoid frequently differ in no respect from other inguinal hernias and these organs are of moderately common occurrence in large hernial sacs. But at times, especially in general visceroptosis (Glénard's disease) the cæcum and sigmoid descend from the iliac fossæ by a process of slipping of the iliac peritoneum (*hernie en glissade*) leaving the abdomen either as a direct or much less commonly as an indirect hernia. At first a sac is present, but later as the hernia enlarges, the peritoneum of

which it was composed assumes a more and more anterior position, the bowel coming down from behind it. Ultimately only a partial sac is to be found in front and high up the bowel itself forming the posterior and inferior wall of the sac (Fig 459) Some of these cases supposed to be congenital, are conjecturally attributed to overaction of the gubernaculum testis but elongation of the mesentery and enteroptosis furnishes a better explanation

Hernia of the bladder.—The bladder is occasionally met with projecting into the sacs of inguinal or femoral hernias at other times it is seen especially in the direct form of inguinal hernia in elderly subjects with prostatic obstruction or pulmonary disease, and in the perineal and pudendal hernias, presenting as a bulging fleshy mass quite uncovered by peritoneum In such cases great care must be exercised not to mistake it for a thick-walled sac. The presence of loose muscular fibres running in various directions and of large veins on its surface should be noticed, and any doubt as to its character cleared up by the passage of a rigid bougie the beak of the instrument being turned into the protrusion. The nature of the hernia may be suspected when, in such patients a history is obtained of the swelling being more marked before, and less prominent after micturition.

The chief characteristics of hernias which lack a peritoneal sac are those of irreducibility and liability to incarceration this applies especially to hernias of the cæcum and sigmoid.

TREATMENT OF HERNIA IN GENERAL

The following points must be considered, bearing in mind that only two methods are available, *viz.* palliative and operative and that only the latter is *curative.*

Age. *Infancy* —Hernia has occasionally been cured spontaneously in quite young children. In most cases it is *not* cured, for although apparently so it frequently reappears in early adult life. The difficulty of treating young children by palliative means is considerable for the following reasons Their restlessness and irritability and their constant crying tend to force the rings open and shift the truss their skin is tender and in the poorer classes is easily excoriated by the accumulation of dirt and sweat beneath the truss constant increase in size demands a relay of fresh trusses the tissues are so delicate that the perpetual pressure of a truss probably does more harm than good the ignorance of the mothers in the poorer classes, and the question of expense result in the treatment being improperly and intermittently applied.

The objections to operation during infancy are the possibility of spontaneous cure, the delicacy and weakness of the tissues, and the danger of fatality or of sepsis.

In young adults a hernia can only be cured by operation The surgeon's decision will be influenced by the following factors —

1 The well-known progressive tendency of hernia.

2. The influence of hard manual labour on the one hand and of sedentary occupation on the other both of which conditions favour the growth of a hernia.

3. The constant danger of strangulation.

4. The influence now exerted by the Employers Liability Act, which makes it very difficult for any man who is ruptured to obtain employment.

5 The greater prospect of permanent cure the earlier the operation is undertaken.

In old age.—At the age of 50 and over hernias tend to become very large and the tissues much degenerated and although operation is still capable of curing many of these patients, the recurrence-rate the risk to life, and the difficulties of the operation are greater

PALLIATIVE TREATMENT OF HERNIA

This consists essentially in (*a*) the reduction of the hernia, and (*b*) the application of some form of truss to prevent its re-descent.

In the earlier stages of hernia the saccular contents return to the abdomen, by their own weight, on the patient lying down. Later on, for reasons already given there is some delay in the process and manual pressure is required to effect the reduction even this may at first fail, and the return may only be accomplished after some hours of recumbency with or without the use of the ice-bag and the Trendelenburg position, both of which tend to empty the vessels of the omentum and reduce the size of the swelling

Reduction by manipulation.—The patient is placed in the recumbent position, the thighs are flexed upon the abdomen to relax the abdominal muscles, and, in the case of inguinal and femoral hernia, are rotated inwards to relax the fascia of the thigh and the neck of the sac. The latter is then grasped by one hand in such a way as to straighten out the body of the sac, while with the other hand pressure is evenly applied to the fundus, gently but firmly in such a manner as to favour the return first of that portion of the contents occupying the neck, following which the contents of the fundus will usually slip back easily In the case of omentum alone, the sudden flaccidity of the sac will indicate the completion of the process, while in that of bowel the characteristic gurgle of air and fluid will be both felt and heard at the moment of reduction.

Gentleness is most essential in these manipulations, since roughness or clumsy force if the hernia is difficult of reduction, can only result in pain to the patient in bruising and inflammation of the sac and its contents, thus producing early irreducibility and possibly even in rupture of the sac, "reduction *en masse*, or *strangulation*. *On no* account should force replace patience and skill.

At times a hernia may be irreducible simply from the fact that any attempt at reduction is resisted by the patient, owing to griping pains, the abdominal muscles being involuntarily contracted at each attempt this difficulty may be overcome by making the patient keep the mouth wide open and instructing him to breathe deeply and not to hold his breath. This failing, a general anæsthetic or preferably spinal analgesia may be employed the muscular relaxation provided by this latter method being very marked.

The direction of pressure during reduction will vary with the position of the sac. In umbilical hernia it should be directly backwards, but these hernias are so commonly irreducible at an early date that, when they do not reduce spontaneously little success is to be expected from manipulation. The direction in inguinal hernia should be upwards and outwards towards the iliac spine. In femoral hernia it will depend much on the direction of the fundus of the sac. This reduction is always more difficult to effect owing to the tendency of the sac to turn upwards to Poupart's ligament, the narrowness of the canal, and the sharp edges of the saphenous opening and Gimbernat's ligament, besides which the sac cannot be lifted in the hand as in the case of inguinal hernia. In most cases the pressure must be in a downward and inward direction.

The dangers of using undue force are dealt with under "Reduction *en masse*" (p 657).

Treatment by truss.—The disadvantages of trusses are as follows —

1 They do not *cure* any hernia (a very small proportion in quite young infants possibly excepted)

2. They are inconvenient and often uncomfortable.

3. They are costly for poor patients, who as a rule soon wear them out.

4. They are frequently badly fitted or not fitted at all.

5 In a few years the hernia, growing larger overcomes the truss.

6 Their pressure tends to thin out and mat together the underlying tissues, rendering any future operation much more difficult and the chances of cure much more remote.

7 In young children a constant change of truss is necessary to ensure accuracy of fit at different ages.

8. Although useless and dangerous in irreducible hernias, they are *often* applied to these by ignorant patients.

If used, the truss must be neither too strong nor too weak in the spring, must be of a proper fit and pattern, and only be applied in the recumbent position *after* the hernia has been reduced.

The most popular *variety is the circular spring truss* a modification of this with a prolonged perineal pad, known as the "rat tail truss, is sometimes more efficient for large inguino-scrotal hernias. The Moc-main truss gives more with the movements of the body but is readily damaged

For inguinal hernias in children the best forms are the india rubber horseshoe-shaped truss and the woollen-skein truss. The former is the better but is expensive, for new ones must be bought as the child grows and the rubber deteriorates on the moist skin of a young child *and may cause irritation. The skein is applied as follows A thick* skein of undyed berlin wool is passed round the waist from behind forwards the end on the side of the hernia is threaded through its fellow and drawn taut, so that the crossing lies immediately over the inguinal canal With the child in the recumbent position the hernia is reduced, a cotton wool pad placed beneath the crossing, and the free end of the skein carried back through the perineum and fixed to the girdle portion just to the outer side of the sacro-iliac joint. The skein should not be removed in the bath, but replaced by a dry one afterwards.

For umbilical hernia in an infant a bandage over a pad is sufficient no pad small enough to enter the umbilical ring must be used. Nothing is better than a leaden disc covered with lint or cotton wool and sewn to the binder

Indications for use of a truss.—Unless there is some definite contra-indication to operation the surgeon will do well to advise a radical cure at any age. Trusses may however be advisable in infants under 18 months of age, in patients refusing operation or out of reach of *surgical assistance, in those in whom any surgical* interference is contra-indicated, e.g in the victims of hæmophilia, diabetes, or nephritis, and sometimes in very old people.

The characters of a well fitting truss should be as follows The spring should lie closely to the pelvis without undue pressure at any point. It should control the hernia when the patient, standing with legs wide apart and thighs everted, and stooping so as to rest his hands on his knees, exerts his full expiratory force. The pad should be soft and elastic, and rather flat. The pad should fall not on the external abdominal ring, but on the whole length of the inguinal canal.

OPERATIVE TREATMENT

The principles governing a true radical cure are—(1) complete removal of the sac (2) closure of the hernial aperture and (3) the production of an unstretchable cicatrix.

In some cases the first of these will suffice, but in most cases all three are required and in a few the last is the most essential

Indications for operation.—Some form of operation is especially indicated in—(1) patients between the ages of 18 months and 65 years (2) all wage-earning workmen (in view of the Employers Liability Act) (3) married women or women about to marry (4) patients going out of reach of surgical help (5) where the hernia is irreducible (6) where there have been signs of strangulation (7) where there is a gradual increase in size (8) where the hernia is associated with an undescended testis (9) where a truss, having been worn, no longer controls the hernia.

Contra indications—It is open to question whether operation is desirable in patients over the age of 65 and the physical condition of the patient must be the determining factor here. In hernias of such gigantic size that the return of the abdominal contents presents a serious risk of paralytic ileus, operation should not be attempted without serious consideration. In cases of hæmophilia, diabetes, albuminuria of pathological origin, and severe anæmia, operation is definitely contra-indicated.

Chief factors tending to a successful result.

1 Complete obliteration of the sac and its diverticula.—This is considered by some surgeons to be the chief essential, and it is so in quite young children. But in the case of adults the long-continued presence of the hernial contents has widened and stretched the ring, and converted much of the sound muscular tissue into fibrous material hence operative repair of the abdominal walls is imperative in addition. The presence of lateral sacculi, especially in femoral hernia, must be remembered, since, if overlooked, the reappearance of the hernia may be accounted as a recurrence when it is only an evidence of faulty technique.

2 Avoidance of tension in suturing—Neglect of this precaution will result in the rapid cutting out of the deep sutures, the recession of the muscles covering the gap and the formation of an excess of fibrous cicatrix.

3. Perfect dryness of the wound—The result of oozing of blood, serum, and liquid fat into an operation wound is in the first place, to furnish a nidus for bacterial growth, which is especially favoured in the vicinity of the groins and genitals secondly it separates the layers of the abdominal wall near the wound and, thirdly it

increases the amount of fibrous tissue by organization of the exudate, and thus tends ultimately to atrophy of the muscular layers involved in it.

4. Sufficiently prolonged convalescence.—Few things tend so greatly to vitiate the result of hernial operations as an undue curtailment of convalescence. Young cicatrices are easily stretched long after the occurrence of primary union. The present-day custom of discharging hospital patients at the end of fourteen to twenty-one days is a directly predisposing cause of recurrence.

Operative Treatment of Inguinal Hernia

The operation may be divided into two essential parts, viz. (*a*) the obliteration of the sac and (*b*) the closure of the canal. In *Bassini's* operation, the one usually adopted the sac is emptied and removed, the open neck being closed either by transfixion and ligature or if wide by suturing this method secures good results and is advised. *Barker* recommended ligature and removal of the sac the stump being afterwards carried upwards by the two ends of the ligature passed through the abdominal wall and tied together there. *Macewen* puckered up the sac like a venetian blind by a purse-string suture from below upwards and fixed it as a pad over the internal abdominal ring In *Kocher's* first operation the fundus was passed through the muscles above the internal ring, from within outwards, the sac drawn after it and then turned downwards and fixed to the anterior surface of the external oblique aponeurosis. Later Kocher invaginated the sac into the abdomen like an inverted glove-finger and bringing it out through peritoneum and muscles, fixed it as above.

To close the inguinal canal, two methods may be mentioned—(1) *Halsted's* in which the inguinal canal is obliterated by suturing all the layers of the abdominal wall *behind* the cord, which therefore is made to run subcutaneously to the scrotum (2) *Bassini's*, in which, after removal of the sac the conjoint tendon is stitched to Poupart's ligament behind the cord, and the gap in the external oblique closed in front of it, so as to maintain the valvular action of the canal.

Choice of anæsthetic.—The best results are obtained with spinal analgesia, which procures a maximum of muscular relaxation, avoids postoperative vomiting, and minimizes oozing and congestion. (See Vol. I., p 737)

Bassini's operation (Fig 460) —1 The incision extends from a point just external to the pubic spine outwards, parallel to and slightly above Poupart's ligament, for a distance of 4 in. or more. In the case of a scrotal hernia it may be necessary to extend it downwards over the outer aspect of the scrotum, but this should be avoided if possible for three reasons firstly for fear of sepsis

secondly on account of the troublesome oozing following division of the hernial coverings here and thirdly because of the difficulty of bandaging the scrotum satisfactorily

The aponeurosis is next split from the external abdominal ring outwards and the edges held widely apart by flat retractors—*not* by pressure forceps, which tend to tear the edges. The spermatic cord is raised from its bed, and the sac sought. If three fingers are passed beneath the cord and the coverings are divided in its length by a light touch of the knife and then peeled upwards and downwards with the point of a pair of dissecting forceps, there will be no difficulty in recognizing the transverse white fold which marks the fundus of the sac.

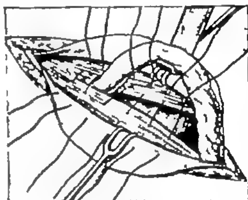


Fig. 460.—Bassini's method of closing inguinal canal.
(*From Annals of Surgery.*)

Then, avoiding injury of the cord like vas the sac is stripped from the surrounding tissues as high as its origin from the parietal peritoneum, and the fundus is opened. A finger is introduced, the sac is explored, any adherent omentum being detached, and the bowel reduced lateral sacculi must be dissected out and removed with the sac. The finger being still kept in the sac to prevent the escape of contents, the neck is transfixed by a needle carrying a ligature, and is firmly tied off as close to the abdominal wall as possible. The sac is then removed at a short distance from the ligature If separation of the sac threatens damage to the vas, or such injury to the vessels of the cord as would be followed by testicular swelling, the detached distal portion of the sac may be left *in situ*.

2. With the finger or the handle of a scalpel the peritoneum is stripped back from the deep aspect of Poupart's ligament, and the conjoined tendon is similarly peeled back from the overlying aponeurosis of the external oblique as far as possible. At this point the question will arise as to the necessity of reinforcing the inguinal canal by the method described on p 637 where the patient is young the musculature good, and the hernia not of unusual size nor recurrent, this will not be necessary The cord is held out of the way and four or more stout, chromicized, iodized catgut sutures inserted through a half inch grip of the conjoined tendon and through the upturned

edge of Poupart's ligament, from the pubic spine to the internal abdominal ring The sutures are then tied *just sufficiently tightly to approximate the structures included* and so to remake the posterior wall of the inguinal canal.

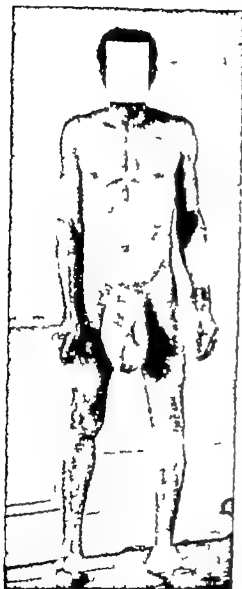


Fig 401 —Scrotal hernia with vaginal hydrocele, cured by filigree implantation. (*Author's case*)

Care must be taken to avoid puncturing the deep epigastric vessels.

3. The cord is replaced in position and the wound in the aponeurosis closed, the edges being caught up in the manner of a Lembert's suture, which prevents the tendency to split sufficient room being left for the escape of the cord from the canal without undue constriction. Finally in stout patients *the superficial fascia may be* approximated by one or two sutures so as to obliterate any dead space" and the skin incision is closed by interrupted silkworm-gut sutures, or preferably by Michel's clip-sutures. During the application of the bandage the patient's thigh should be flexed and internally rotated, so that when the limb is straightened the bandage pressure is applied most firmly *over the hernial region.*

Operative Treatment of Large Scrotal Hernias

Certain large scrotal hernias cannot be cured by any method which relies upon the patient's tissues alone The musculature *is no longer firm* and resilient, and frequently the inguinal region external to the internal abdominal ring is weak and bulging In very large scrotal hernias the sac, especially the body and fundus, is thick vascular and adherent and the

attempt to strip this out of the scrotum results in much troublesome oozing of blood and fat which not only distends the cavity of the scrotum, but also invades the layers of the coverings of the sac making it impossible to evacuate the clot. It is thus often unwise to attempt the removal of such a sac it is better simply to detach it sufficiently at the neck to enable it to be ligated and divided here thus the risk of a scrotal hæmatoma is avoided at the cost of a comparatively slight increase in the size of the scrotum. This increase may be considerably reduced by the use of a large-sized Keetley's suspender worn for some weeks after the operation.

If the scrotum is very long and flabby a section of it may be removed but no attempt should be made to cut away the thick coverings of the sac, since much time must be lost in catching and tying divided vessels.

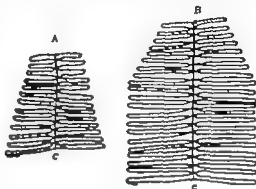


Fig. 462.—Pubic (A) and iliac (B) sections of author's filigree for inguinal hernia. (C) Midrib.

Double-filigree operation author's method. Principles involved.[1]— It was with the idea of bringing recurrent hernias and those of great size within the scope of operative treatment, that I devised in 1906 the method known as the double-filigree method. The principles which underlie it are, simply the removal of the sac the approximation of the conjoined tendon to Poupart's ligament, and the rendering absolutely unstretchable of the whole operative cicatrix by the introduction of a scaffolding of silver wire known as filigree. When an aseptic filigree of silver wire is introduced into the tissues of the inguinal canal, there follows exudation of lymph, which rapidly organizes about the filigree, and in a very short time new vessels and young fibrous tissue are produced, and entangle themselves among the wires of the filigree to such an extent that a solid plaque is formed that converts the inguinal canal into a sound, resistant area which will neither stretch nor bulge, the muscles, peritoneum, and aponeurosis being welded together by the filigree.

Method of constructing filigrees.—These are made in two sections (Fig. 462) a pubic (A) and an iliac (B) The former measures 1½ in. in length (the normal length of the inguinal canal) ¾ in. in width at the narrow end, and 1½ in. at the wide end. All

[1] This passage is extracted from the *Brit. Med. Journ.*, Aug. 14, 1909, where fuller details will be found.

Operative Treatment of Femoral Hernia

The skin incision in this case may be a vertical one over the site of the saphenous opening, and extend from ½ in. above the inner point of trisection of Poupart's ligament downwards for a distance of 4 in. A network of veins will be met with formed from the superficial epigastric and circumflex iliac, and the superficial external pudic vessels these must be divided between ligatures. The sac will usually be found without difficulty lying in the superficial fascia and directed towards the centre of Poupart's ligament, the neck being long and narrow and curving round the falciform process of the fascia lata to reach the parietal peritoneum.

The neck should be entirely freed from its surroundings as high as possible, and treated exactly as described under inguinal hernia, the first four of the precautionary points there mentioned being again borne in mind

The necessity of using some means for closing the femoral canal has been much debated by surgeons, and the following methods may be mentioned here —

1 Three or four catgut sutures (*not* mattress sutures) may be passed deeply through the substance of the pectineus muscle, and then through the falciform process and lower edge of Poupart's ligament, so that, when tied, these two structures are closely approximated, and the saphenous opening is partially obliterated. This method does not, however close the upper end of the femoral canal, and involves the exercise of considerable tension if the saphenous opening is to be even narrowed for this reason the sutures probably cut out early and do more harm than good.

2. An attempt has been made to cover the gap by turning up a flap of the pectineus muscle and fascia, and suturing it to Poupart's ligament. The only effect of this has been to damage the pectineus muscle, and since the transplanted flap undergoes fibroid degeneration, no good results from it.

3. An attempt has also been made to suture Poupart's ligament *to the horizontal ramus of the pubes by passing deep sutures round* the ramus or through the periosteum covering it.

4. With a similar object an endeavour has been made to unite these two structures by the use of steel staples driven through the ligament into the bone. The method fails owing to the rarefying osteitis which shortly loosens the grip of the staples, and is moreover dangerous, since the points of the loosened staples are apt to wound the bladder and femoral vessels.

5 The femoral canal has been plugged with decalcified bone or with a graft of bone raised from the ramus of the pubes.

6. *Operation via the inguinal route*.—In the experience of the reviser of this article by far the best operation for the cure of femoral hernia is that performed by an approach through the inguinal region. An incision similar to that used for an inguinal hernia is made above and parallel to Poupart's ligament: the aponeurosis of the external oblique muscle is divided parallel to its fibres, and the spermatic cord and conjoined tendon are hooked upwards and medially. Then a little blunt dissection readily exposes the neck of the sac as it passes between Gimbernat's ligament on its mesial, and the femoral vein on its lateral aspect. The incision is now hooked downwards to expose the tissues below Poupart's ligament, and the sac is dissected free from the surrounding fat and traced up to the crural opening. The sac may then be opened, its contents, if healthy, reduced into the abdominal cavity, and the sac pushed up through the crural canal to above Poupart's ligament. Its neck is ligatured high up and the sac removed. The crural canal is now closed as follows: Placing one finger of his left hand on the femoral vein above Poupart's ligament, in order to guard it, the surgeon passes two sutures from the inner aspect of Poupart's ligament to the tissues lying upon the ilio-pectineal line of the pubis, taking a wide grasp of these and including the periosteum. When these sutures have been tied the upper opening of the crural canal will be found to be effectually closed. Care must be taken to avoid injury to or constriction of, the femoral vein. This operation has the following advantages: (1) It ensures removal of the whole sac high up and close to the peritoneum; (2) it closes the upper entrance to the crural canal; (3) in those cases where there has been a doubt as to the diagnosis between a bubonocele and a femoral hernia, the incision is suitable for either variety; (4) it enables the surgeon to explore the cord and to detect the presence of a latent inguinal hernial sac; (5) in the case of a strangulated femoral hernia it greatly facilitates the division of Gimbernat's ligament, which can now be seen from above as well as felt from below: the risk of damage to an abnormal obturator artery is therefore minimized; (6) resection of gangrenous gut can be done in the inguinal region entirely outside the abdomen: this method is especially useful in strangulated femoral hernia.

If desired, the closure of the crural canal can be further solidified by a suture or two between the upper part of the fascia over the pectineus and the outer aspect of the median end of Poupart's ligament.

The most important step is that of complete removal of the sac and care must be taken to ensure that no lateral sacculus is overlooked.

Operative Treatment of Umbilical Hernia

The points to be aimed at are complete removal of the sac and the closure of the abdomen *in separate layers*

The incision is made in the middle line of the abdomen above and below the hernia, the actual prominence being enclosed by an ellipse between these incisions. Where there is a deep layer of superficial fascia, the skin incision must be long enough to give free access to the hernia. The abdomen is opened above the level of the hernia, and a finger is introduced to search for adhesions. These are separated and the incision is then carried through the whole thickness of the abdominal wall along one side of the tumour and the sac everted and emptied of its contents. Any adherent omentum is ligated and removed, care being taken to see that all vessels in the stump are fully secured. The sac, including its cutaneous covering, is then removed close to the neck of the hernia. If the gap is very wide it is often well to avoid too free a removal of the peritoneal sac, lest difficulty be found in closing the abdomen without the exercise of tension. The bowels are now retained by a large gauze pad placed within the abdomen, and the peritoneum is closed by a continuous suture the pad being removed before closure. The margins of the rectus sheath are laid open above and below the gap and the edges of the posterior layers approximated like those of the peritoneum. The rectus muscles are brought out of their sheaths and their edges united by interrupted sutures which should include a considerable thickness of the muscle on either side, without the least constriction. If approximation can only be effected by the exercise of tension, either the muscles must be more freely brought out or the case must be treated by filigree implantation (see p 643)

In freeing the muscles it is necessary to detach them from the lineæ transversæ which bind them to their sheaths. This is easily done, but as these lineæ transversæ carry large vessels, care must be taken to arrest all bleeding before proceeding to unite the muscles. Only round bodied curved needles should be used here, since bayonet edged or Hagedorn's needles are liable to divide muscular branches of the vessels and so give rise to bleeding and cause loss of time. The anterior layers of the rectus sheaths are now united by a continuous suture one or two interrupted sutures are inserted to hold the superficial fascia together and obliterate dead spaces, and finally the skin incision is closed by Michel's clips. A firm binder should be applied for the first twenty four hours, and the patient should be placed in the semi-recumbent position.

Where the hernia has attained to rather larger dimensions, various attempts have been made to strengthen the abdominal wall by the overlapping of its aponeuroses the best of these overlapping opera

tions is that of William Mayo. The incisions are transverse and elliptical, and are carried down to the neck of the sac after which the aponeurotic surfaces are cleared for a distance around this point. The sac, its coverings, and its omental contents are removed by a circular incision without dissection. A transverse incision is made through the abdominal aponeurosis (posterior rectus sheath) for an inch or less on either side and the peritoneum is separated from the upper of the two flaps thus made. Sutures are now passed through the aponeurotic layer of the upper flap about 3 in. from its free margin from without inwards, then through the free margin of the lower flap, and back again through the upper flap from within outwards, and are sufficiently drawn upon to approximate the peritoneal edges, which are closed by a continuous suture. This done the sutures are so tightened that the lower aponeurotic flap is drawn into the space between the upper flap and the peritoneum, where it is fixed. The free margin of the upper flap is then sutured to the surface of the aponeurosis below and the skin incision finally closed.

The operation is not suitable for very large hernias, and the separation of the peritoneum is frequently difficult owing to old adhesions.

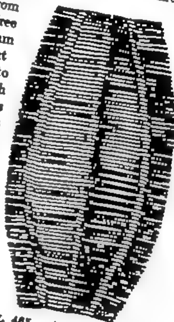


Fig. 465.—Author's modification of Bartlett's abdominal filigree.

Filigree implantation.—For hernias which have grown so large that any prospect of cure by ordinary means is out of the question, this method is the only one which can be relied upon. It is simple and effective but often necessitates a very extensive and tedious operation.

The filigree which I use (Fig. 465) is a modification of Willard Bartlett's original pattern in that it is barrel-shaped in outline, and has two side-ribs as well as a mid-rib. It is made in precisely the same manner as the filigrees for inguinal hernia (p. 637) except as regards shape and size. The method is in all respects that of Bartlett, except that the filigree is implanted between the rectus muscle and the posterior layer of its sheath instead of upon the peritoneum.

The incision must be very extensive often indeed from the ensiform cartilage to the pubes (Fig. 455, p. 618). The rectus sheath must be very freely opened on either side and a complete separation of both muscles effected from both anterior and posterior layers. As

soon as the edges of the peritoneum, together with those of the posterior layers,[1] are united, all oozing is arrested, and the edges of the recti muscles being widely retracted, the filigree is lifted straight from the sterilizer and at once introduced into the wound, being laid upon the posterior layer of the sheath of the muscle. There is no need to suture it in place, since, being of the exact width of the sheath it cannot get out of place. The recti muscles are now approximated as far as possible over it, and the anterior layer of the sheath is also closed by a continuous suture. No drainage is used, and the wound is closed by the clips from end to end.

Before operation is undertaken, the size of the filigree to be used must be determined. The vertical length of the hernial gap should be measured, and the filigree made at least one-third longer than this measurement the width remains constant—4½ to 5 in.

When successfully implanted, these filigrees do away entirely with the necessity for any kind of belt or truss after convalescence. The patient may wear an abdominal binder for a month from the date of the operation, when consolidation will be complete. In my experience no inconvenience or discomfort is felt subsequently nor *does the method interfere with pregnancy*

Operative Treatment of Ventral Hernia

What has been said of umbilical applies equally well to ventral hernia. Unless the gap is from the first very large, success may be obtained by the superimposition of flaps But if there has been damage to the nerve supply of the abdominal wall, and consequent muscular atrophy there is a great tendency to recurrence after approximation of the abdominal wall in tiers. It is best to treat such cases by filigree implantation from the first.

Since they are commonly the result of trauma or of operative interference they *present greater difficulties than simple umbilical* herniae owing to the nature of the cicatrix and adhesions this is especially so where there has been extensive suppuration, or where abdominal drainage has been employed.

The majority are situated between the umbilicus and the pubes and consequently there is a deficiency of the posterior sheath of the rectus in the lower half of this area. The filigree must therefore lie on the posterior sheath in its upper and on the peritoneum in its lower half, and should come well down below the crest of the pubes.

Appendicular and other lateral hernias.—Whenever drainage of an appendicular abscess, or reposition after caecostomy

[1] Unless these are taken together the peritoneum will be much torn by the sutures.

or colostomy has been performed, a ventral hernia is to be expected if comparatively small and surrounded by muscle that has retained a good nerve supply cure may often be obtained by approximation of, the fascial and muscular layers. But if the gap be very large, so that approximation of muscular layers can only be made with tension, or if there be considerable atrophy due to loss of nerve supply a filigree should be used. The situation is not one which lends itself to the application of belts or trusses, and the discomfort of this variety of hernia is greater in proportion than that of any other form of ventral hernia, since the sac always contains the cæcum and ileo-cæcal valve or the sigmoid which structures are often adherent to its walls. For this reason also much of the peritoneum may be sacrificed in detaching these adhesions. The filigree in such cases as these is introduced as follows —

The skin cicatrix having been excised by an elliptical incision running obliquely from the loin to the pubes, the abdomen is opened at the upper end and the adhesions are determined as above detailed. The peritoneum is separated as widely as possible from the abdominal muscles external to the incision, and the rectus sheath is opened extensively along its outer edge. The muscle is then freed from the sheath above and from the peritoneum below the semilunar fold of Douglas. When the oozing is arrested and the edges of the peritoneum are approximated, the filigree is introduced so that its inner loops rest on the posterior sheath of the rectus muscle above, and on the peritoneum below while its outer loops lie on the peritoneum only and are deep to the abdominal muscles. The rectus is then brought well out of its sheath and is sutured to the transversalis and internal oblique muscles over the filigree, while the anterior layer of the sheath is united to the external oblique aponeurosis. The skin incision is finally closed in the usual way

When implanting a filigree, in a case in which the abscess has been drained without the removal of the appendix, it is essential, for obvious reasons, to effect this removal at the time of implantation.

The most rigid asepsis is necessary for successful filigree implantation therefore sufficient time should be allowed to elapse to reduce the danger of "residual infection after operation for a septic condition, e.g appendicitic abscess.

Operative Treatment of Lumbar Hernia

When occurring at Petit's triangle, hernia may often be cured by simple approximation of the muscles but if the gap be wide it may also be submitted to filigree implantation. When the hernia appears in the upper region of the loin this is sometimes the only sound method of treatment especially when it is the result of an operation on the

kidney Here the muscles have been divided transversely much of their nerve supply may have been damaged, and extensive fibrosis and atrophy have occurred. The filigree may be placed upon or deep to the transversalis fascia, the latter being the simpler method. The operation is by no means so simple as in the case of the abdomen, owing to the narrowness and depth of the costo-iliac space and the unyielding nature of the fascia. The filigree should measure about 4 to 5 in in length and 3 to 4 in. in width, and should be of the same shape as the abdominal filigree.

Operative Treatment of Gluteal and Sciatic Hernia

These hernias may occasionally be operated upon when not strangulated The incision and dissection are in all respects the same as for ligature of the respective arteries, the essential point being to obtain very free access to the parts. The difficulties are chiefly those of depth, the presence of the network of vessels, and the difficulty of effecting reduction. In dividing the constriction, care must be taken of the vessels and nerves in the vicinity and as these are numerous and their courses not always regular it is wiser to depend on clear exposure of the parts than to be guided by any anatomical rule. In case of failure, abdominal section should be performed as for obturator hernia (see p 662)

Operative Treatment of Perineal Hernia

The majority of perineal hernias should be attacked by the combined abdomino-perineal route. They are extremely difficult to deal with and so variable in their character that no definite rule can be laid down for their operative treatment. The difficulties to be over come are the reposition and retention in place of the pelvic organs, especially the bladder which at times occupies the sac and the depth of the hernial ring both from within and from without. The Trendelenburg position is, of course, essential, and there are no sound structures to assist in closing the gap. My spider web filigree, shaped like the familiar octagonal spider web, may be used, being implanted either beneath the peritoneum from within, or beneath the levator ani muscle from without, as may be found easiest. In either case it should lie between the peritoneum and the muscle the sac having been invaginated and tied off within the abdomen In women this may necessitate the separation of the broad ligament from the pelvic floor but that is of little consequence, since it can easily be sutured in place again. Where the hernia is found to contain the ovary broad ligament, uterus, and bladder it will be advisable to complete the operation by performing a ventro-fixation of the uterus, and

possibly removal of the ovary and tube of the affected side at the same time.

The greatest care must be taken to ascertain the presence or absence of the bladder in these cases, since any injury to it in so deep a wound is difficult to repair On one occasion a pudendal hernia appearing in the labium majus was mistaken for a vaginal polypus, and being ligatured and removed was found to contain a length of intestine and a mass of omentum (Graser see Bibliography p 669)

POSTOPERATIVE COMPLICATIONS OF HERNIA

These fortunately are few The following have been noted —

1 **Chronic pain and hyperæsthesia of the cicatrix.**—This is probably due to the inclusion of some of the cutaneous nerves in the ligatures and sutures. If severe and genuine (many of these patients are malingerers or neurotic youths) the cicatrix may be undercut with a tenotomy knife where the condition is one of hyperæsthesia, but where chronic pain is complained of, it is better to open up the old wound down to the aponeurosis, or even to the conjoined tendon and divide high up any nerves found in the course of dissection. Where pain is complained of only in wet or cold weather the condition is not to be benefited by operation.

2. **Formation of a hæmatoma.**—This may occur in the course of the inguinal canal or in the scrotum. It is not uncommon after extensive stripping away of large adherent sacs in scrotal hernias. Unless very extensive or causing a distinct rise of temperature, these hæmatomas should not be opened, especially when in the scrotum it is almost impossible to evacuate all the clot from this region, since besides occupying the cavity of the scrotum, it has extensively invaded the layers of the hernial coverings, from which it cannot be dislodged. It is better to use the ice-bag for the first twenty four hours, and hot fomentations or simply pressure after this. Unless very large these swellings nearly always subside in time. When suppuration occurs they must be freely opened, but in such cases the hernia commonly recurs.

3. **Atrophy of the testis.**—This is due either to (a) damage to the vas deferens by cutting or crushing (b) damage to the spermatic artery or (c) compression of the spermatic cord by too tight suturing of the canal. When atrophy is established there is no remedy

4. **Formation of a varicocele.**—This is also due to tight suturing, and is, indeed, often a stage in the previous condition. When suturing is complete, the external abdominal ring should admit the tip of the little finger although with difficulty

5 **Torsion of the testis.**—As the result of twisting the organ round in the process of removing a patent processus vaginalis

especially in cases of retained testis, this accident may occur the testis being finally left in the scrotum with the digital fossa, as it should be, on the outside, but with a complete twist of the cord above it. Such an accident may give rise to pain, swelling of the scrotum, vomiting, distension of the abdomen, and constipation the case may thus resemble one of intestinal obstruction. The accident can only be the outcome of carelessness.

6 **Persistent vomiting.**—The importance of this lies in its effect on the result of the operation Its cause may be (*a*) the anæsthetic (*b*) intestinal obstruction (*c*) torsion of the testis (*d*) general peritonitis or (*e*) paralytic ileus.

The danger of forcible and prolonged vomiting is that it strains or ruptures the sutures, tears the conjoined tendon stretches the young cicatrix of the union and causes fresh oozing into the tissues, all of which effects tend to produce recurrence. Since the introduction of spinal analgesia into my practice there has been only one case of prolonged vomiting (viz. five hours) this was in a woman, and was not violent. The use of spinal analgesia is a strong factor in the prevention of recurrence.

7 **Intestinal obstruction.**—This may result from the tying-in of a loop of bowel in the neck of the sac or from the production of a volvulus, or the forcing of a loop of bowel through a rent in the omentum or mesentery by a rough attempt to return large masses of hernial contents. The prophylaxis is obvious the treatment, immediate laparotomy

8. **Fæcal or urinary fistulæ.**—These are the outcome of direct injury to the bowel or bladder from transfixion by sutures or inclusion in ligatures or in the case of the bowel, they are due to subsequent sloughing at the site of constriction when a strangulated loop has been released and returned to the abdomen.

Either of these conditions may improve spontaneously after a time, or may require an operation to effect a cure. In the case of the bladder a catheter should be tied in and the cavity washed out twice a day without forcible distension the patient should be given such drugs as hexamine in 10-gr doses acid sodium phosphate ʒss salol 10 gr., etc., in such vehicles as infusion of buchu, pareira, barley water etc.

When the bowel has been damaged much will depend on the level of the injury If it be in the upper regions of the jejunum emaciation will ensue rapidly whereas fistula of the colon produces little change in the nutrition

9 **Suppuration.**—Owing to the situation of inguinal and femoral operations, asepsis is more difficult to ensure than in the case of ventral or umbilical hernia. But in all cases the greatest care must be taken

to avoid infection of the wound since suppuration is almost certain to be followed by recurrence. Absorbent and unabsorbable sutures like silk and linen thread should be avoided, since they often give rise to sinuses of prolonged duration. The safest material is probably catgut soaked in ether and then treated by Claudius's or Moskowitz's iodine method. Where deep suppuration occurs, nothing is gained by waiting except where a filigree has been implanted the wound should be reopened, all sutures removed, the wound thoroughly cleansed with flavine, and an effort made to get it clean enough to permit of an early secondary suture. If this cannot be done, drainage must be established later if recurrence takes place operation may be performed again after three or four months.

10 **Retention of urine.**—In all operations on the groins or perineum this is liable to occur from time to time it is a temporary complication of no great importance, and is readily overcome by the use of a catheter

11 **Orchitis and epididymitis.**—This is seen in a certain proportion of inguinal hernias. It usually comes on within the first four or five days after operation, and may last for a week or ten days, gradually subsiding on the application of hot fomentations, or the use of glycerine and belladonna the patient's bowels should be kept freely open, and the testes should be kept raised upon a pad of soft wool supported on a band of strapping passed across the thighs. The prognosis is good, suppuration being rare, and little damage resulting to the testes. The trouble is probably due to rough handling of the vas and to congestion of the pampiniform plexus of veins.

12. **Paralytic ileus.**—This is by far the most serious complication of hernial operations, and is rarely met with except in the case of prolonged manipulation of the bowels in dealing with unusually large hernias, especially umbilical ones in plethoric subjects. The symptoms are those of gradually oncoming intestinal obstruction, and unless the bowels can be induced to move the case is likely to terminate rapidly If distension occurs and cannot be relieved by the rectal tube and turpentine enemata, time should not be wasted in the administration of drugs, but the abdomen should be opened and the cæcum or distal end of the ileum brought out of the wound, and a Paul's tube inserted, after which sulphate of magnesium, etc. may be given. Eserine salicylate and pituitrin are also of value, and may be given hypodermically Where vomiting has actually set in, the prognosis is very grave and where the vomit is fæcal, the case is, as a rule, hopeless.

In extreme cases, where the manipulation gives reason to fear the possibility of ileus, prevention is better than cure and the cæcum

should be opened at the time of operation, a Paul's tube being inserted and the bowels evacuated at once. Such drastic treatment must, of course, be reserved for the most exceptional cases.

Recurrence of hernia after operation.—Although less commonly seen than formerly recurrence is still far from rare, and may be met with as the result of—

1. Suppuration, *which accounts for about 60 per cent. of all cases.*

2. Badly chosen cases and unsuitable methods. Thus, even Bassini's method is incapable of dealing with large hernias, especially in men over 40 and in the presence of atrophied abdominal walls. Operations done under general anæsthesia on patients the subjects of asthma or bronchitis are likely to result in failure.

3. Tightly tied sutures—especially if 'mattress sutures' are used, since strangulation of the tissues is produced and the sutures cut out too soon. The forcible dragging down of the conjoined tendon is apt to produce a separation of the muscular fibres above the level of the inguinal canal. The practice of dragging up the neck of the sac by sutures, passed through the abdominal wall and then tied produces a cicatrix and therefore a weak spot in the muscle, and this may easily be the starting point of a recurrence. In my opinion the practice is unsound and should be abandoned.

4. Unduly short convalescence this should *never be less* than three weeks in bed and one week on a couch or chair.

5 Postoperative vomiting this is best avoided by the use of spinal analgesia.

6 The overlooking of lateral sacculi in a hernia this, however is rather a failure to cure than a recurrence.

7 Omission to relax the tension on the sutures after operation, by flexion of the knee and hip

8. Constipation, which induces straining, especially when the patient has to use a bed pan. The bowels should be kept loose and the semi recumbent (Fowler) position permitted during the act.

9 Distension due to flatulence this applies especially to abdominal hernia.

10 Allowing the patient to come round from the anæsthetic before application of the bandages. A sudden spasm of vomiting is often enough to rupture the deep sutures and undo the whole of the work.

After-treatment of hernial operations.—Firm bandaging should be the rule after operation, a soft, thick pad of wool being placed over the part to prevent any oozing On his return to bed the patient's hips and knees should be semiflexed and kept in this position by means of a rest or pillow for a period of a fortnight in cases of inguinal and femoral hernia when any plastic closure has been attempted.

For some time after the bandages are discarded, while the cicatrix is still young the rings should be supported by the pressure of the hand during defæcation coughing, or other expulsive effort. *On no account should any form of truss be applied*

In young children care must be taken to prevent the soiling of the dressings with urine or fæces, by frequent inspection of the bandages and immediate redressing where necessary With very young and restless children it may even be advisable to apply some form of retentive apparatus, such as a vertical suspension as for fractured femur or a Thomas's hip splint slightly bent to a suitable shape and fixed by plaster bandages. In babies it is often convenient to omit

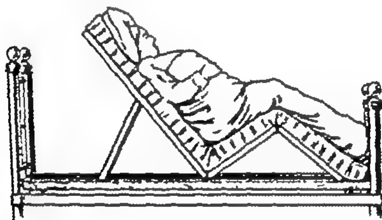


Fig. 466.—Double inclined plane (Fowler's position)

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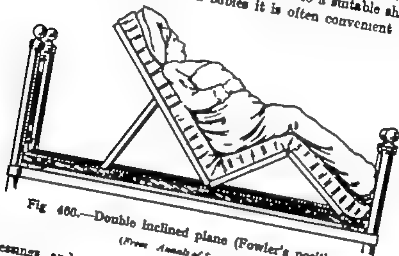


Fig 466.—Double inclined plane (Fowler's position)
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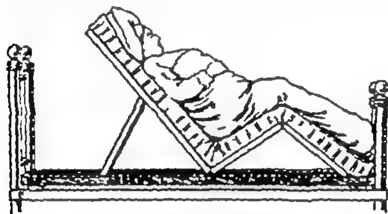


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Unless the patient complains of discomfort, the binder applied after operation should not be loosened for twenty four hours a tight binder is a great safeguard to the sutures after a general

anæsthetic, but it may be a source of danger to the patient's respiration if distension is marked.

STRANGULATED HERNIA

Strangulation—that is, the constriction of a viscus, usually the bowel, in such a manner as to cause arrest of its circulation as well as of its nerve supply and natural function—is one of the commonest of surgical emergencies. It may occur at any time in the life-history of a hernia, and is not infrequently the first evidence of the presence of hernia. It is met with in all the forms of hernia already mentioned, as well as in certain others known as internal hernias, since they are confined to the abdominal cavity in these latter strangulation is the rule, and they are rarely seen except in this condition.

The effects of strangulation vary according to the age and condition of the patient, the portion of the bowel involved, and the tightness of the constriction. Thus, although if unrelieved, either spontaneously or by operation the inevitable result is death this result is much more rapid when the patient is old and feeble or excessively plethoric, and the constriction tight and high up in the intestinal canal. In such cases the fatal result may ensue in the course of three or four days, whereas in less unfavourable cases seven to ten days may elapse. The cause of death is commonly exhaustion, peritonitis, or septic pneumonia.

Cardinal symptoms of strangulation—These are essentially those of intestinal obstruction, viz. (1) vomiting (2) absolute constipation both as to flatus and fæces (3) gradual distension of the abdomen and (4) the appearance of an irreducible swelling in the neighbourhood of one or other of the hernial sites.

1 **Vomiting**—At first this may be mere effortless regurgitation of the gastric contents preceded by a sense of over fullness of the stomach, possibly in spite of the fact that no food has been taken. In the course of a few hours the vomiting becomes worse and is accompanied by active retching bitter greenish-yellow bile-stained fluid being ejected in mouthfuls. As time goes on, the vomiting progresses, undiminished by drugs, and large quantities of foul-smelling brown liquid are brought up, having a distinctly fæculent odour Ultimately if the condition is unrelieved and the patient lives sufficiently long the actual contents of the large bowel may be vomited this, however is rare

2. **Constipation**—This may not at first be complete some of the contents of the rectum below the constriction being voided but it very soon becomes absolute, neither fæces nor flatus passing the anus. An occasional exception to this is met with in the case of Richter's hernia (p 627) especially when low down in the ileum slight action of the bowels and little vomiting being present throughout. The diagnosis is thus rendered very difficult.

3. **Distension of the abdomen**.—When increasing rapidly and especially when supervening on rigidity of the parietes, this is a sign of great importance. It may be due to gas within the bowel or free in the peritoneal cavity. The diagnosis is not always easy. Stress is laid by some writers on the absence of liver dullness, but the sign is very deceptive, the bowel at times being able to insinuate itself between the liver and the abdominal wall, thus giving rise to the belief that there is free gas in the peritoneal cavity. However, taken in conjunction with other signs of abdominal disaster, such as sweating, collapse, rapid pulse, and marked abdominal facies, it is of value. The rapidity of the onset of distension must be considered in the diagnosis of its cause. Thus a gradual, slow development is the rule in strangulation, whereas rapid and acute increase suggests perforation of the bowel.

Distension may occur even when omentum only is strangulated, the paralysis which originates it being due to reflex inhibition of the splanchnic nerves.

4. **Appearance of a swelling**.—The above signs, in association with a swelling at the umbilicus, groin, saphenous opening, or other hernial site (especially when the swelling is irreducible or has recently become so, is tender on manipulation, and transmits no expansile impulse on coughing), present a picture the significance of which should be obvious. The swelling is always tender, and the pain is referred to the umbilical region.

For the rest, the condition of the patient is as follows. The tongue is thickly coated, at first with dirty white fur, later becoming dry and brown, and sordes form on the lips. The patient's face assumes the sunken, anxious appearance known as "facies Hippocratica," his voice becomes feeble and conversation is carried on in whispered gasps, articulation being indistinct owing to dryness of the tongue. The breath becomes horribly foul, the pulse rapid and running, the temperature often subnormal; gradually exhaustion sets in, and the patient dies in a comatose, asthenic condition. At times death is due to inhalation of fæculent vomit and subsequent gangrene of the lung or septic pneumonia; or, the bowel becoming gangrenous, general septic peritonitis terminates the case.

Varieties of strangulated hernia.—All the forms of hernia may undergo strangulation, but that most frequently affected *in proportion* is the femoral variety, although inguinal strangulation is the more often met with. Umbilical is less frequent, but more serious, since it occurs in obese and elderly women of plethoric habit. Ventral hernia rarely becomes strangulated, owing to the wide neck of the sac, whereas obturator, sciatic, and gluteal hernias are rarely seen except in the condition of strangulation, which generally occurs on their first appearance.

Retrograde strangulation.—This is a rare variety first described by Maydl, in which the contents of the sac remain normal, but in which a part of such contents having retraced its steps and passed into the abdomen again, becomes there strangulated. It has been described affecting bowel, omentum, the appendix, and Fallopian tube. (Sultan see Bibliography p 669)

Causes of strangulation.—A hernia which has been spontaneously reducible for years may become strangulated as the result of—

1 **Some excessive exertion** such as the lifting of a heavy weight, defæcation, vomiting, coughing, etc. the immediate effect being the forcing of a fresh mass of omentum or a coil of bowel into the sac the neck of which is too narrow for it or the production of a volvulus of bowel already in the sac.

2. **Some violence applied from without**, such as foolhardy and clumsy attempts at the reduction of an irreducible hernia the result being its conversion into one of the forms of "reduction *en masse*, the setting up of an inflammatory œdema of the sac or its contents ; or the forcing of the bowel through a rent in the omentum.

3 **Simple rapid increase** from overgrowth of fat, of the omental contents of the sac.

4. **Sudden distension of the bowel** in the sac from acute enteritis.

5 **Gradual increase** in the bulk of an incarcerated mass in the bowel.

6 **The growth of a tumour** in the sac.

Of the above causes, the first is by far the commonest.

Pathology of strangulation. — The process may be divided into three stages, between which there is no real dividing line, but which are easily recognizable at operation and are important as a guide to treatment and prognosis. The first stage is that of congestion from venous engorgement, the bowel being cyanosed and the omentum dark and covered by large loops of over filled veins. As the result of this, œdema of the contents shortly occurs, and the pressure within the sac is increased. Soon the engorgement becomes so great that fluid accumulates in the sac, and this is frequently turbid or blood-stained. The sac is now tense, and the bowel becomes deep-purple in colour and blood may be effused into its lumen.

The second stage is marked by the loss by the bowel of its smooth, glistening appearance by its blackish-grey colour and by its wet-wash-leather consistence. The fluid now becomes distinctly fæculent in odour

The third stage is that of actual gangrene of the bowel, or of ulceration and perforation at the site of constriction.

In the case of Richter's hernia, where only the lateral wall of the bowel is involved, it is clear that perforation may take place without the signs already described as characterising strangulation being present.

Results of untreated strangulation.—The prognosis is usually fatal at times, however recovery takes place as the result of the formation of a fæcal fistula on the surface of the body

Strangulated inguinal hernia.—Inguinal hernia becomes strangulated more frequently in males than in females, owing probably to the nature of their work the immediate cause is usually the descent of a fresh mass of omentum, and it is more commonly the latter which is strangulated. The constricting agent is to be found either in the rigid pillars of the external abdominal ring, or in the fibrous band which commonly surrounds the neck of the sac. Only occasionally is the hernia strangulated on its first appearance. Owing to the wider nature of the ring and canal here, the symptoms take rather longer to establish themselves than in the case of femoral hernia

These hernias are usually scrotal, and on examination the scrotum will be found to be distended, hard, tender dull to percussion, or when bowel is present with resonance diminished owing to the presence of fluid in the sac. No expansile impulse is felt on making the patient cough. Any attempt at reduction is resisted owing to the pain, and the patient lies with the thigh of the affected side drawn up and inverted in an endeavour to relax the tension. In many cases there is rigidity of the abdominal muscles on the affected side, and retention of urine is not uncommon. Pain may be complained of in the testis and loin owing to pressure on the constituents of the cord and in time cramping pain referred to the umbilicus is felt. In the case of women, the ovary may be contained in the sac, in which case pain is referred to the "bottom of the back" (sacralgia) as well as to the umbilicus and may be aggravated by raising the cervix uteri per vaginam. The appendix in a strangulated hernia gives rise to no sign by which its presence can be recognized.

Strangulated femoral hernia.—As compared with inguinal, this strangulation is more serious in that, being less outwardly obvious, it is more liable to be overlooked being transmitted through a narrower canal, it is more acute in its onset and with the sharp edge of Gimbernat's ligament always in close contact with it, ulceration is more prone to occur early

It is seen especially in women (since in them femoral hernia is commoner) at all ages but chiefly between the ages of 30 and 50 The tumour produced is usually quite a small one, and if of recent occurrence may easily be mistaken for an enlarged gland there is, however no periglandular thickening, in spite of the tenderness the

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Causes of strangulation.—A hernia which has been spontaneously reducible for years may become strangulated as the result of—

1 **Some excessive exertion** such as the lifting of a heavy weight, defæcation, vomiting, coughing, etc. the immediate effect being the forcing of a fresh mass of omentum or a coil of bowel into the sac, the neck of which is too narrow for it or the production of a volvulus of bowel already in the sac.

2 **Some violence applied from without**, such as foolhardy and clumsy attempts at the reduction of an irreducible hernia the result being its conversion into one of the forms of "reduction *en masse*," the setting up of an inflammatory œdema of the sac or its contents or the forcing of the bowel through a rent in the omentum.

3 **Simple rapid increase** from overgrowth of fat, of the omental contents of the sac.

4. **Sudden distension of the bowel** in the sac from acute enteritis.

5 **Gradual increase** in the bulk of an incarcerated mass in the bowel.

6. The **growth of a tumour** in the sac.

Of the above causes, the first is by far the commonest.

Pathology of strangulation.—The process may be divided into three stages between which there is no real dividing line, but which are easily recognisable at operation and are important as a guide to treatment and prognosis. The first stage is that of congestion from venous engorgement, the bowel being cyanosed and the omentum dark and covered by large loops of over filled veins. As the result of this, œdema of the contents shortly occurs and the pressure within the sac is increased. Soon the engorgement becomes so great that fluid accumulates in the sac and this is frequently turbid or blood-stained. The sac is now tense and the bowel becomes deep-purple in colour and blood may be effused into its lumen.

The second stage is marked by the loss by the bowel of its smooth glistening appearance, by its blackish-grey colour and by its wet-wash leather consistence. The fluid now becomes distinctly fæculent in odour

The third stage is that of actual gangrene of the bowel, or of ulceration and perforation at the site of constriction.

In the case of Richter's hernia where only the lateral wall of the bowel is involved, it is clear that perforation may take place without the signs already described as characterising strangulation being present.

Results of untreated strangulation.—The prognosis is usually fatal at times, however recovery takes place as the result of the formation of a fæcal fistula on the surface of the body

Strangulated inguinal hernia.—Inguinal hernia becomes strangulated more frequently in males than in females owing probably to the nature of their work the immediate cause is usually the descent of a fresh mass of omentum, and it is more commonly the latter which is strangulated. The constricting agent is to be found either in the rigid pillars of the external abdominal ring, or in the fibrous band which commonly surrounds the neck of the sac. Only occasionally is the hernia strangulated on its first appearance. Owing to the wider nature of the ring and canal here the symptoms take rather longer to establish themselves than in the case of femoral hernia.

These hernias are usually scrotal, and on examination the scrotum will be found to be distended, hard tender dull to percussion, or when bowel is present with resonance diminished owing to the presence of fluid in the sac. No expansile impulse is felt on making the patient cough. Any attempt at reduction is resisted owing to the pain, and the patient lies with the thigh of the affected side drawn up and inverted in an endeavour to relax the tension. In many cases there is rigidity of the abdominal muscles on the affected side and retention of urine is not uncommon. Pain may be complained of in the testis and loin owing to pressure on the constituents of the cord and in time cramping pain referred to the umbilicus is felt. In the case of women, the ovary may be contained in the sac, in which case pain is referred to the "bottom of the back" (sacralgia) as well as to the umbilicus and may be aggravated by raising the cervix uteri per vaginam. The appendix in a strangulated hernia gives rise to no sign by which its presence can be recognized

Strangulated femoral hernia.—As compared with inguinal this strangulation is more serious in that being less outwardly obvious, it is more liable to be overlooked being transmitted through a narrower canal, it is more acute in its onset and with the sharp edge of Gimbernat's ligament always in close contact with it ulceration is more prone to occur early

It is seen especially in women (since in them femoral hernia is commoner) at all ages but chiefly between the ages of 30 and 60 The tumour produced is usually quite a small one and if of recent occurrence may easily be mistaken for an enlarged gland there is however no periglandular thickening, in spite of the tenderness the

mass is spherical rather than lobulated, and not adherent to the skin and unless the sac is inflamed there is no redness over it, such as usually denotes femoral adenitis.

The cause of strangulation is similar to that in inguinal hernia, but the constricting agent is always the knife-edge of Gimbernat's ligament. This structure is so prominent that reduction, either spontaneous or intentional, is almost impossible and is seldom seen. For this reason, too any prolonged effort at taxis is more dangerous than in inguinal hernia "reduction *en masse*" is less, while rupture of the bowel is more likely to occur as a result.

Strangulated umbilical hernia.—This condition is almost confined to women of the age of 40 to 60 especially those who are markedly obese, of plethoric habit, and frequently the subjects of chronic asthma and bronchitis. For these reasons umbilical strangulation is very dangerous, and its mortality high. Reduction can very rarely be effected owing to the size of the mass, its omental adhesions, the tightness of the constriction, and the numerous lateral sacculi present. The constricting agent is in this case the neck of the sac itself, and this is often of almost cartilaginous consistence. The especially dangerous nature of the strangulation is further due to the following factors The depth and extent of the wound necessary for its relief the jejunum as well as the transverse colon and omentum being at times involved, the shock is proportionately greater than when the lower end of the ileum is in question the size of the mass to be exposed and returned, many feet of bowel being frequently involved the fact that such patients are bad subjects for any kind of operation more especially those which involve resection, anastomosis, or drainage of the intestine if jejunostomy is required, rapid emaciation is likely to result the amount of handling necessary to replace these large hernias in an abdomen already full of tensely distended bowel frequently leads to the occurrence of paralytic ileus.

Case for case, strangulated umbilical hernia is attended by a worse prognosis than any other form of external strangulation, and therefore admits of less delay in its relief next to it comes femoral, and lastly inguinal strangulation.

TREATMENT OF STRANGULATED HERNIA

The only sound and safe method when strangulation of any variety of hernia has been diagnosed is immediate operation.

Employment of taxis.—When a case of apparent strangulation comes under consideration the question will arise as to the justifiability of taxis for its reduction. In only a few cases, however is it possible, and in fewer still is it safe it should only be used as a last resource as where a patient obstinately refuses any operation

If it can ever be said to be justified it can only be where the trouble is of but a few hours duration in a hernia hitherto easily reducible where there is absence of pain and tenderness, and even then it should be of the gentlest kind, and should neither be prolonged nor repeated

Dangers of forcible taxis —1 " Reduction *en masse* (Figs. 467 to 474) The following remarks apply especially to *inguinal* hernia.

When a hernia which is irreducible or strangulated is subjected to forcible manipulation with a view to its reduction, certain displacements of the sac or of its contents may result these displacements known as "reduction *en masse*," may take various forms

The whole sac with its unreduced contents may be displaced upwards—(i) subcutaneously between the skin and the abdominal wall (ii) interstitially between the internal and external oblique muscles (Fig. 467) or between the transversalis muscle and the peritoneum (properitoneal) (Fig 468) (iii) behind the iliac peritoneum, cæcum, or sigmoid (retroperitoneal)

The sac may be ruptured circularly at the neck and *the contents* forced into any of the above positions the body and fundus remaining behind (Fig 469)

The sac may be ruptured laterally and the contents forced through the rent either interstitially as above, or simply into the scrotum (Fig. 470)

The contents may be forced from the main sac to a lateral diverticulum (Fig. 471)

The contents may be forced through a rent in the omentum and the whole reduced into the abdomen, the sac remaining behind (Fig. 472)

The bowel may be reduced across an adhesion at the neck of the sac (Fig 474)

2. The bowel may be torn across at the neck of the sac (Fig 473) general peritonitis rapidly terminating the case.

3. Short of rupture, serious hæmorrhage may be produced in the sac or such bruising may take place that gangrene rapidly supervenes

Reduction *en masse* is thus a very serious condition, since it suggests for the moment that reduction has been correctly performed, although an irreducible hernia may have been converted into a strangulated one, while a strangulated hernia may be allowed to persist. When suspected, the only possible treatment is immediate laparotomy The possibility of the occurrence of "reduction *en masse*" should be thought of where a very sudden reduction effected under considerable pressure is accompanied by sharp pain, and is followed by persistence of the signs of strangulation, or by those of general peritonitis. The mortality of operation in such cases is of course very high.



Fig. 467.—Interparietal (subaponeurotic) reduction.

E.A., External oblique aponeurosis; O., internal oblique muscle; O. pubes; T. V., tunica vaginalis.

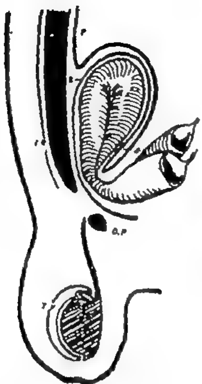


Fig. 468.—Properitoneal reduction.

P., Peritoneum; S. sac in peritoneal position; I.O., conjoined internal oblique and transversalis muscles; O. pubes; T. V., tunica vaginalis.



Fig. 469.—Rupture of neck of sac, bowel reduced interparietally.

A., Aponeurosis; bowel; H.S., hernial sac; P., peritoneum; O.P. pubes; T. tunica vaginalis.

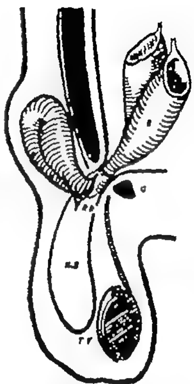


Fig. 470.—Subcutaneous reduction through rent in sac.

H.S., Hernial sac; T. tunica vaginalis; O. pubes; B. bowel; R.S. rent in sac.

REDUCTION EN MASSE.[10]

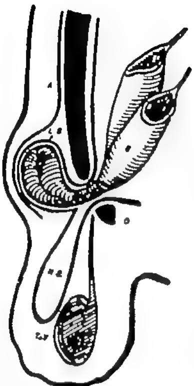


Fig. 471.—Reduction into lateral sacculus.

L.S., Lateral sacculus; H.S., hernial sac; A, aponeurosis; B, bowel; O, pubes; T V, tunica vaginalis.

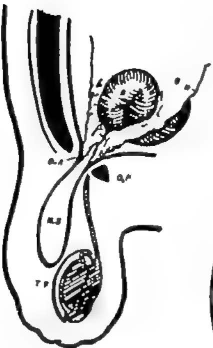


Fig. 472.—Reduction through rent in omentum.

H S., Hernial sac; O, pubes; T V, tunica vaginalis; O., omentum; O.A. omental adhesion; B., bowel.

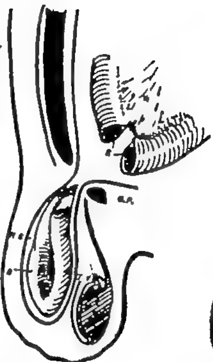


Fig. 473.—Rupture of bowel at neck of sac.

H.S. Hernial sac; B. bowel; R. point of rupture; O.P. pubes; T V tunica vaginalis.



Fig. 474.—Reduction across an adhesion at neck of sac.

A' Adhesion band; B' bowel; O. P. pubes; H.S. hernial sac; T. V. tunica vaginalis.

REDUCTION "EN MASSE."

In very early cases it may be possible to assist taxis by placing the patient in the Trendelenburg position, and applying an ice-bag for some time before the attempt is made or by the use of ether applied drop by drop to the swelling These methods may reduce the volume of gases in the intestine and diminish the congestion to some extent, but on the other hand there is the danger of producing thrombosis in the constricted vessels. In any case, time is thus lost. A better method is to submit the patient to spinal analgesia or to general anaesthesia, proceeding at once to operation if taxis fails.

OPERATIVE TREATMENT OF STRANGULATED HERNIA

Precautions.—The following precautions must be observed prior to operation —

The preliminary cleansing is best done by swabbing with acetone followed by painting with iodine or picric acid (see Vol. I. p. 299) *without* the previous use of soap and water

In every case where possible the patient's stomach should be washed out. This is especially necessary where a general anaesthetic is to be employed, the danger of inhalation of faeculent vomit being considerable. Septic pneumonia following, or even asphyxia during operation may be the result of neglecting this precaution. In any case the material, if retained in the stomach, is highly toxic.

Every precaution must be taken against shock, which is often marked in these cases. Extract of pituitary gland (pituitrin) may perhaps be given *hypodermically when the obstruction has been relieved* (if given before it causes painful spasms) while during the operation two or three pints of dextrose solution (2½ per cent.) in normal saline, should be intravenously infused. The body must be kept warm.

Rapidity of operation should be aimed at, and no attempt made to complete the operation by radical cure at the moment if the patient is showing signs of exhaustion.

Since the condition of the bowel is always an unknown quantity nothing should be overlooked in the way of apparatus, when it is obtainable, which may be required for the drainage, resection, or anastomosis of the bowel. In emergencies, however wide rubber tubing may take the place of a Paul's tube and flat pieces of wood, their ends surrounded by rubber bands, make excellent intestinal clamps

Neither purgatives nor enemata should be given the former are dangerous and useless, and the latter being retained, *as they are sure to be* will probably be voided on the table.

Kelotomy—The incision should in all cases be a wide one much time may be lost in attempting to operate through a cramped space. All structures are divided down to the sac itself, from which they should be separated, provided the patient's condition does not

compel haste The fundus of the sac is then caught up in three pairs of pressure forceps, and is opened This must be done carefully with the edge (not the point) of the scalpel, the flat of the blade lying on the surface of the sac, unless this is done, there is danger of the bowel being carried by the sudden rush of fluid under tension in the sac or by the sudden expansion of flatus, against the point of the knife and so being injured. The escaping fluid should be caught on a pad and its colour and smell noted. If it be turbid blood-stained or fæculent, care should be observed in handling the bowel since such signs point to ulceration at the point of constriction no attempt should be made as yet to draw down the bowel for inspection in view of this possibility The sac is opened to the neck, and the colour and surface of the bowel or of the omentum must be noted. The bowel must now be released by division of the constriction, the method depending on the variety of hernia.

In inguinal hernia.—If the hernia is an oblique one, a Cooper's hernia director is passed along between the bowel and the neck of the sac, so that its groove faces the anterior superior spine the hernia knife is passed along it on the flat, and the back of the knife being turned into the groove, the two instruments are pushed along together their handles more or less widely separated according to the depth of incision required. In this way the neck of the sac of an indirect hernia is divided *upwards and outwards* so as to avoid the deep epigastric vessels which lie along its inner side. If the hernia is a direct one, the incision must be made *upwards and inwards* the director being passed along the inner aspect of the bowel. In spite of the width of the director bowel will at times tend to overlap its edges, especially in wide-necked sacs with much bowel the greatest care must be taken in these cases not to injure the latter

In femoral hernia.—Here the structure to be divided is Gimbernat's ligament, which lies just internally to the neck of the sac. In doing this the occasional peculiar origin of the obturator artery from the deep epigastric must be remembered. This vessel should arise from the anterior branch of the internal iliac artery giving off, just before it enters the foramen the little pubic branch which anastomoses with the pubic branch of the deep epigastric. Occasionally this branch may be so large, and the obturator itself so small, that the latter may be said to arise from the deep epigastric. In this case the vessel will be found to occupy one of three positions (*a*) It may lie at some distance internally to the sac (*b*) *it may cross* the posterior aspect of Gimbernat's ligament or (*c*) it may closely follow *its external margin*, hugging the neck of the sac. In the last position it would almost certainly be divided in the act of incising the constriction. Statistics as to the frequency of this accident do not help

to prevent its occurrence ; the constriction must be divided, and if by chance the accident should happen, three courses are open to the surgeon (a) The bowel being returned, an effort may be made to catch the vessel in the wound—a very difficult matter owing to the narrowness and depth of the latter (b) The deep epigastric may be tied this may fail owing to the free collateral circulation here. (c) The tying of the *deep epigastric may be supplemented by ligature* of the external iliac artery Fortunately the accident is of rare occurrence and is still less likely to occur if the inguinal route of operating, recommended on p. 661 be adopted ; it may to some extent be avoided by using a hernia knife with a slightly blunted edge, since the tense ligament is more readily cut than the lax vessel. The director should be passed with the groove facing the pubic spine, and the incision made directly inwards, no more being done than is necessary to free the bowel.

In umbilical hernia.—The incision may be made upwards or downwards usually without danger the director is rarely necessary since the constriction, being due to the fibres of the linea alba can be divided from without if there is still a constriction due to the neck of the sac, this too can be dealt with from without.

Operative treatment of obturator hernia.—For reasons already given (see p. 622), this hernia is rarely submitted to operation except when strangulated. The skin incision should be made vertically downwards and inwards from a point 1 in. external to the pubic spine, *for a distance of 5 or 6 in. This will lie along the inner* edge of the femoral vein. The femoral vessels are retracted outwards and a separation is effected between the adductor longus and pectineus muscles. The bulging of the hernial sac either through the obturator canal or through the muscle-fibres should now be seen. If access to the parts is difficult, the fibres of the pectineus muscle may be divided care being taken to avoid its nerve which lies behind it. If an attempt to reduce the hernia fails, a hernia director is passed along the neck of the sac *above or below* and the hernia knife passed along it so as to divide the constriction either upwards or downwards, the vessels usually lying anteriorly or posteriorly to the neck of the sac. Failing success in reduction *by this method* the abdomen *should* be opened to the hernial side of the middle line, and reduction effected by gentle traction from within, the greatest care being taken not to rupture the bowel, nor to allow of the escape of foul-smelling or blood stained fluid into the abdominal cavity The sac is then transfixed tied, and removed, and the wound is closed.

Gluteal and sciatic hernias can be released by a downward incision, but in these cases the irregularity of the vascular anastomosis may be considerable and the best rule is that of free access to

the parts by a wide incision, the division being effected by careful dissection.

Is the bowel recoverable?—As soon as the constriction has been divided, the state of the bowel must be ascertained. It should be gently withdrawn from the wound, remembering always that the release must be sufficiently free to permit of this being done without the least force; for if at this moment a tear should occur at the constriction, the bowel above being tensely filled with liquid fæces and flatus, the lower abdomen is immediately flooded and the patient's doom is sealed.

Bowel may be classified as "safe," "doubtful," or "dangerous." It is "**safe**" when—there is no lymph on its surface; it has not lost its gloss; œdema and bogginess are absent; there is neither ecchymosis nor constriction-slough at or near the neck; it gradually returns to its normal colour on being released; the mesentery is not discoloured by blood extravasation; the fluid in the sac is clear and free from odour.

It is "**doubtful**" if—there is much delay in the return of colour on being released; it has lost its gloss; the fluid is blood-stained.

It is "**dangerous**" when—it is black and boggy; the constriction remains clearly outlined on the surface; the fluid is foul and blood-stained.

"*Safe*" intestine may be returned to the abdomen after being gently washed with normal saline at a temperature of 110° F.; after which, if the patient's condition is good, the usual radical operation may be performed. Otherwise, the wound is closed and a pad applied to prevent the return of the hernia; the radical operation being deferred till later.

"*Doubtful*" or "*dangerous*" *bowel*.—Two courses are open to the surgeon here. He may either resect the strangulated portion, reuniting the cut ends by some form of intestinal anastomosis, or fixing the loop in the wound, he may open it and introduce a Paul's tube. The choice of method will depend chiefly on the condition of the patient. Resection is the ideal method and should be done even where the bowel is "doubtful," but the decision to attempt it must be influenced also by the length of bowel to be resected, the portion of the bowel involved, the character of the strangulation, the experience of the operator, the availability of skilled assistance, and the patient's surroundings as regards light, cleanliness, and materials for so serious an operation. Roughly speaking, resection is indicated (*a*) where the patient is not over 60, is not exhausted by vomiting, and cardiac and pulmonary disease are absent; (*b*) where the small intestine is involved; (*c*) where the amount of bowel involved is not

so great as to preclude the possibility of success [1] (d) where the operation is done by one skilled in surgical technique and rapid operating and (e) where it can be done under spinal analgesia. Strangulated omentum should *always* be resected.

Formation of a fæcal or intestinal fistula.—This is the only safe treatment where the patient is old, feeble, and exhausted by pain and vomiting, and where the mass is too great for resection and anastomosis. It should also be done, as a rule, in strangulation of the large bowel, in preference to primary resection, which has a higher mortality than in the case of the small bowel because the blood supply is less extensive and more longitudinal, and therefore union is more difficult to secure, the contents are more solid and more irritating, the arrangement of the musculature is less adapted to anastomosis, and flatus accumulates with greater rapidity here.

It should not, however, be done when there is reason to suppose that the strangulation is high, for although life *can* be saved by artificial feeding through the jejunum for a considerable period, as proved by me in conjunction with Bruce Clarke, it is extremely difficult, and would not succeed in all cases alike.

Points regarding the methods of operating.—When resection and anastomosis is proposed in the case of inguinal or femoral hernia, *it is better that the operation should be done in situ* than that the abdomen should be opened and the damaged bowel withdrawn through the abdominal wound for the purpose. When a perforation exists there is danger of soiling the peritoneum, while even when none is present, the manipulation necessary to reduce the damaged bowel, especially when wrapped in gauze as a precautionary measure, is likely to result in a tear and in extravasation of the contents. In performing the anastomosis the hernial aperture must be enlarged, the bowel must be well drawn through the ring from the abdomen, the damaged part resected, the junction thoroughly cleansed, and reduced. Where foul fluid is present, a light gauze wick or a "cigarette" drain should be placed in the wound for twenty-four hours.

The surgeon may be faced with the difficulty of dealing with a section of intestine which is gangrenous, or at least "dangerous," at two or more points. He must rapidly determine on one of three courses: he must *either (a) perform two or more* separate resections, (b) resect the whole length of bowel involved, or (c) bring the whole length outside the abdomen and make an intestinal fistula or an

[1] *A length of anything over 3 feet must be looked upon as serious, although as much as 11 feet has been successfully removed.* Spinal analgesia has greatly lessened the danger of resection.

artificial anus. Each case must be judged on its merits, and the following points will help in the decision —

1. A large section may be resected and an anastomosis performed more rapidly than two short sections; thus a prolonged operation is avoided.

2. When, however, the section to be removed is very long (6 to 8 ft.) the shock may be equally great; in even longer sections it may be much greater than from the resection of two separate sections.

3. When the gangrenous portions are situated one in the small and the other in the large bowel, the former may be resected and the latter converted into an artificial anus for the time being, when the patient cannot stand two resections.

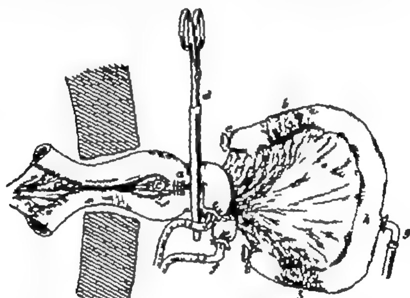


Fig. 475.—Exclusion of gangrenous bowel and formation of intestinal fistula.

a, Sutures joining loops; b, b, gangrenous sections; c, rod supporting bowel; d, bowel clamp; e, e, ligatures on bowel; f, f, Paul's tubes in cut ends; g, Paul's tube in excluded loop; h, site of incision in loop.

4. Extensive resections are attended by a mortality which is largely in inverse ratio to the skill and rapidity of the operator. For this reason, in unpractised hands, the emergency is best met by the third method, viz. exclusion of the affected loop and the formation of an intestinal fistula.

For this purpose the sound bowel having been brought down to the ring, the entering and returning coils are connected side by side by one or two interrupted sutures (Fig. 475, a) some distance from the gangrenous portions (b) and are supported by a short length of rubber

covered glass rod (c) passed beneath the union. A clamp (d) is applied just distally to the union, and a ligature (e) is placed round each portion of the bowel about 1½ in beyond the clamp. Finally the bowel is divided between the clamp and the ligatures a Paul's tube (f) is introduced into each cut end, being fixed by a purse-string suture and the clamp is removed. An incision should be made into the loop at the point (h) and, if necessary a third Paul's tube (g) introduced to prevent it from becoming distended with gas and fluid. The fistula may be rapidly made in this way and the loop with its mesentery may be removed on recovery of the patient at the end of three or four days the anastomosis may be deferred till later unless the fistula is high up in the bowel, when it should be done at the earliest possible date. It may even be done at the time of the first operation in this case a lateral anastomosis is the method indicated.

Where the case is so urgent as to demand it, the loop must be secured to the skin incision and the Paul's tube inserted without the above elaboration. The making of an intestinal fistula *in situ* in the case of femoral hernia is attended by certain difficulties the proximity of the femoral and saphenous veins renders the femoral canal a bad site for the discharge of fæces moreover the canal is often too long and narrow to allow of satisfactory evacuation of the bowel, or its reduction from within by laparotomy when swathed in gauze. In such a case, where the patient is able to stand it, the abdomen may be opened above the pubes the gangrenous loop and its mesentery are surrounded by a double ligature and divided between, the mass being cut away The cut ends are then washed swabbed over with pure carbolic acid, washed again, and seized with a clamp and drawn through the wound into the abdomen the remaining bowels being kept out of the way as far as possible finally the ends are brought out of the abdominal wound, and are treated by anastomosis, or with Paul's tubes in the manner above described.

After-treatment of strangulated hernia.—The indications are—to combat shock, support the patient's strength, and provide against complications.

In a quite uncomplicated case nothing more is, as a rule, necessary than to secure sleep and provide fluid diet. The bowels should be moved at first only by enemata, and after forty-eight hours by calomel given in grain doses every hour up to 5 8 gr this being assisted when needful by a dose of salts or Apenta or other mineral water Pituitary extract or eserine salicylate or strychnine given hypodermically will lessen the chances of paralytic ileus.

Where there has been severe strangulation with fæculent vomit, infusion with normal saline or better still, dextrose saline intravenously (2·5 per cent.) or per rectum (8 per cent.) should be

practised. Two or three pints may be given intravenously but, per rectum the continuous method should be used, the solution being introduced at the rate of half a pint an hour, till the blood pressure is sufficiently raised.

If not done before operation, the stomach should be washed out as soon as the patient's condition admits of it and salol in 5-grain doses administered. The semi-recumbent position (Fig. 466 p 651) should be adopted and the expectoration of the fæculent sputum encouraged by the use of ammonium carbonate in 5-grain doses or other suitable drug

When resection and anastomosis have been performed it is in the highest degree important to prevent any distension of the bowel this is best accomplished by the use of the soft rectal tube passed high and retained *in situ* or by the occasional use of enemata of turpentine or asafœtida.

The feeding of these patients is not, as a rule, difficult. Where no damage to the bowel has occurred it may be carried out on ordinary lines. When resection and anastomosis has been done, nothing but fluids should be given for at least forty-eight hours. Albumin water, beef juice, egg-flip white wine whey Brand's jelly veal or chicken jelly junket, calf's-foot jelly etc. may be given dextrose solution per rectum is in itself a food and has a very high calorific value. On the fourth day if the patient is progressing well, Benger's food, pounded fish or chicken, etc., may be given in small quantities frequently Full diet should not be allowed for a fortnight from the time of operation.

Opium and morphia are best avoided they mask symptoms and cause constipation. Pain must be relieved, if possible, by aspirin in 10-grain doses, and sleep provided by such drugs as veronal 5 gr chloralamide 30 gr., or trional 20 gr. When the case has ended in the establishment of an intestinal fistula, the bowels may be cleared out at once, and feeding started as soon as the stomach has been cleansed and the sickness has ceased.

In the event of recovery the Paul's tube will become detached in about three days, and the question will then arise as to the reconstitution of the bowel This, unless the stoma is high in the canal (jejunum) should not be attempted before the strength is recovered, since there is a danger of union failing owing to weakness and anæmia. In the higher regions the attempt must be made at the earliest possible date by simple suture without detachment of the skin union failing this, detachment should be done, and the lips of the bowel wound should be inverted by two rows of Lembert's sutures. Where this fails, or where there is a marked "spur" resection and anastomosis affords the only chance of arresting the rapid emaciation which occurs. The abdominal wound should not be closed in these cases, as the tissues

are obviously infected it should be allowed to close by granulation, any subsequent hernia being dealt with later.

After-complications of kelotomy for strangulated hernia.—1 Septic broncho-pneumonia is not infrequent when fæcal vomiting has occurred. The prognosis is grave, especially in elderly subjects, and the case may progress to abscess and gangrene of the lung

2. Massive collapse of the lung may occur but will clear up.

3. General peritonitis may result from subsequent sloughing or perforation of the returned bowel. The only possible treatment is immediate laparotomy and cleansing of the abdomen the bowel being brought into the wound as already described, and the abdomen drained through both loins and above the pubes. The prognosis is usually fatal, recovery when it occurs, depending on the interval which has elapsed, the amount of extravasation, and the strength of the patient.

4 Paralytic ileus may supervene on release of the strangulation, or may be actually present when the case is first seen, the vomiting, distension, and inability to pass flatus persisting No time should be lost in opening the cæcum or lower end of the ileum. Owing to the vomiting, drugs can seldom be given by the mouth, and, if the ileus is absolute, little can be done When the strangulation has been seen late in the case this danger is to be feared it is then sometimes justifiable to open the abdomen by a small incision above the umbilicus, and, drawing out a loop of the jejunum, to inject into it 3 or 4 drachms of magnesium sulphate with 10 minims of tincture of nux vomica, closing the puncture by a fine purse-string suture. Puncture of the coils of intestine by means of a trocar and cannula is a tedious process, and seldom succeeds. *The prognosis is commonly* fatal, and prophylaxis is better than attempts at cure. Eserine or pituitrin hypodermically will help.

5 Stenosis may occur at the site of constriction or when anastomosis has been *performed.*

Symptoms of dyspepsia, distension, anorexia, and constipation should suggest the possibility of this complication, especially where the bowel has been slow in recovering its vitality at the original operation.

Prognosis in strangulated hernia.—The probabilities of recovery in an uncomplicated case depend on the duration and character of the vomiting, the age of the patient and his general condition. Up to the time of the vomit becoming fæculent the patient is well within the period of grace when this point has been passed and the odour of the vomit shows the presence of jejunal contents, the prognosis must be considered grave, especially if the vomit is copious, frequent and forcible when the vomit is actually fæcal the time of grace has

passed and, as Handley has pointed out, this sign must be looked upon as a *præsagium mortis*.

The older the patient, the worse the prognosis, since in these cases exhaustion sets in rapidly and the inability to expectorate the foul sputum and mucus from the larynx is very distressing.

When, in a strangulated hernia of some standing and in which vomiting has been active, the vomiting suddenly ceases, the patient going into collapse or as sometimes happens, saying *he feels better* a grave suspicion should be entertained of rupture or perforation of the bowel.

Elderly subjects are more affected by the shock of a tight constriction than are young adults and the exhaustion produced by the vomitless retching of a high jejunal strangulation is in them more profound than when the vomit is in quantity and possibly even fæculent.

In cases complicated by gangrene, perforation, and peritonitis, or in which resection has been performed, it is obvious that the gravity of the prognosis will be proportionate to the duration and height of the strangulation, the period elapsing between perforation and operation, and the length of the section of bowel removed.

SELECTED BIBLIOGRAPHY

Bartlett, Willard, *Journ. of Amer. Med. Assoc.*, 1903, i. 47.
Bonney, Victor, *Arch. of Middx. Hosp.*, Nov., 1910, p. 27.
Clarke, Bruce, *Lancet*, 1907, i. 8.
Graser, von Bergmann's *System of Surgery*, iv. 692.
McGavin, Lawrie, *Trans. Clin. Soc.*, 1907, p. 124; *Trans. Roy. Soc. Med.*, Clin. Sec., 1909, ii. 156; *Lancet*, 1907, ii. 1445; *Brit. Med. Journ.*, 1907, ii. 1336; Aug. 14, 1911.
Mayo, William, *Ann. of Surg.*, 1901, ii. 276; *Journ. of Amer. Med. Assoc.*, July 1903.
Richards, Owen, *Lancet*, 1899, ii. 1386.
Russell, Hamilton, *Lancet*, 1899, ii. 1353; 1902, i. 1519; 1904, i. 707.
Sultan, *Saunders' Hand Atlas*, "Hernia," p. 106.

THE RECTUM AND ANAL CANAL

BY H S CLOGG M S F R C.S

Anatomy.—The rectum commences in front of the 3rd (sometimes the 2nd) sacral vertebra and ends by passing through the pelvic diaphragm about 1½ in below and in front of the tip of the coccyx, opposite the lower part of the prostate in the male and the lower fourth of the vagina in the female It lies entirely within the pelvic cavity and measures about 6 in. in the adult. Its relations are seen

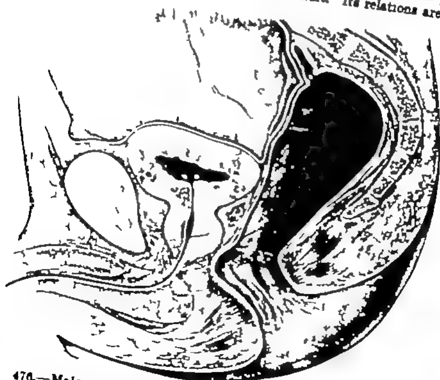


FIG 476.—Male pelvis in vertical median section, showing the rectum and anal canal in section their anterior and posterior relations, and the recto-vesical reflection of the peritoneum.

in Figs. 476, 477 and 478. Narrowest above, it frequently shows a distinct constriction at its junction with the pelvic colon and here a physiological sphincter exists, for the rectum is a passage and not a reservoir for fæces. Just above its termination a dilatation known as the *ampulla* is present.

The upper part except a narrow strip of posterior surface is covered with peritoneum. The serous membrane gradually leaves the sides, and finally the anterior wall the level of reflection varies slightly but is commonly about 3 in. from the anal margin in the child it is relatively lower than in the adult. The peritoneum is intimately attached to the bowel above, but more loosely below

The *longitudinal muscle-fibres* are principally collected into an anterior and a posterior bundle, which are relatively shorter than the rectum itself; hence when distended the bowel shows lateral inflections of its walls. The *circular muscle-fibres* form a complete investment. The thick, vascular mucosa presents numerous folds in the empty gut. Lymphoid nodules are found in the mucosa and submucosa Lieberkühn's follicles are abundant; the surface epithelium is columnar.



Fig. 477 —Female pelvic viscera in vertical section, showing the relation of the rectum to the vagina and the recto vaginal reflection of the peritoneum.

The *rectal valves* (*valves of Houston* Fig. 470) are circular crescentic or spiral folds, best seen in the distended gut, and composed of all the tissues of the bowel wall, except perhaps some of the outer longitudinal muscle-fibres. They correspond in position to the lateral inflections of the wall, and have a similar origin. There are commonly one well marked right valve and two less definite left ones, the former being immediately above the peritoneal reflection and the latter equidistant above and below it.

The anal canal is an antero-posterior slit-like passage, about 1 in. long, leading downwards and backwards to the anal orifice, and forming an angle of 90° with the rectum (Fig. 478). On each side is the ischio-rectal fossa In front the membranous urethra and its enclosing muscles in the male, and in the female the perineal body separating it from the vagina; behind is a mass of muscular and connective tissue—the ano-coccygeal body The

longitudinal muscle-fibres of the rectum are prolonged as a thin investment to the canal, and the levator ani also encloses it. The circular muscle-fibres are considerably thickened, and constitute the *internal sphincter*. This is about 1 in. in vertical extent, and is easily detected on digital examination. Being merely a thickening of circular muscle-fibres, it should have a similar action, and should, therefore, empty the bowel (Cunningham).

The anal canal shows eight or nine vertical folds composed of mucous membrane and muscularis mucosæ—the *columns of Morgagni*



Fig. 478.—Base of the bladder vesiculæ seminales, vasa deferentia, ureters, prostate, membranous urethra, and bulb of the corpus spongiosum, to show the structures in relation anteriorly to the male rectum and anal canal.



Fig. 479.—The rectum opened anteriorly

P, Peritoneum of the anterior and lateral walls of the rectum, and the lower limit anteriorly; H, the valves of Houston, one of which is immediately above the peritoneal reflection.

(Fig. 480). These are permanent, not effaced by distension, well marked in the fœtus, and constant throughout life. Occasionally they are ill marked, rarely they are absent. The columns are broader below and gradually taper above. Their bases (anal ends) are connected by a circumferential irregular "zig-zag" line a little above the anus, thought by some to indicate the line of fusion of the hind-gut and proctodæum (p. 678). The intervening depressions—the

rectal sinuses of Morgagni—end abruptly below and are guarded by the miniature anal valves (the intercolumnar portions of the "zig zag" line). The sinuses and valves vary in development, and are better marked posteriorly. The appearance below the "zig zag" line is whitish, resembling modified skin, whilst above it resembles modified mucous membrane. Squamous epithelium lines the lower part of the canal, and extends to the bases of the columns, columnar epithelium extending to the sinuses. The transformation of epithelium is a gradual one. Sometimes minute tiny pits or depressions are seen on the mucosa of the lower rectum and anal canal. It has been stated that infective disease may originate in these depressions.

Muscles and fasciæ.—The *external sphincter* is a subcutaneous muscle, about 1 in. in breadth, encircling the anus, attached posteriorly to the coccyx

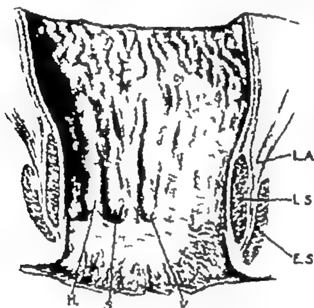


Fig. 480.—The lower rectum and anal canal, incised longitudinally and held widely open.

E.S., External sphincter muscle; I.S., internal sphincter muscle; L.A., levator ani muscle; M., columns of Morgagni; S., sinus of Morgagni; V., anal valve.

and anteriorly to the central point of the perineum. It is superficial to the internal sphincter muscle, the sulcus between the two being readily detected on digital examination of the anal canal. It overlies the fat of the ischio-rectal fossa. It is supplied by the inferior hæmorrhoidal and perineal branch of the 4th sacral nerves.

The *levator ani* and the *coccygeus* form the pelvic floor or diaphragm; they are enclosed in sheaths derived from the pelvic fascia, and with their fascial prolongations help to support the bowel.

The *levator ani* is attached to the back of the os pubis in front and the ischial spine posteriorly and between these two points to the pelvic fascia, near its "white line." The fibres pass downwards and backwards—the anterior ones being almost horizontal and the posterior ones nearly vertical—to be inserted into the central point of the perineum and into the wall of

the anal canal, blending with the external sphincter, while behind the anus the two muscles meet in a median raphe between the anus and the coccyx, and the most posterior fibres are attached to the lower sacral and coccygeal vertebræ (Fig. 481). The upper surface is separated by the pelvic fascia from the prostate, or vagina, and the rectum; the inferior surface, covered by the anal fascia, bounds the ischio-rectal fossa. It is supplied by the perineal branch of the pudic nerve, and by the 3rd and 4th sacral nerves on its pelvic aspect.

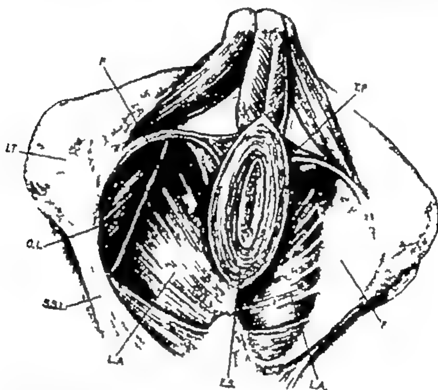


Fig 481.—The ischio-rectal fossæ. The attachment of the external sphincter muscle to the coccyx has been removed.

I.T. ischial tuberosity. G.S.L. great sacro-sciatic ligament. T.P. transverse perineal muscle; E. external sphincter muscle. L.A. levator ani muscle; F. (on the right side), the fascia covering the obturator internus muscle. F. (on the left side), the cut edge of the fascia which has been removed, showing O.I. the obturator internus muscle.

The fibres of the levatores ani passing from the back of the os pubis to meet behind the anus will, when contracted, firmly grip the anal canal, reducing it to an antero-posterior slit. These fibres of the levatores, therefore, form a sphincter to the anal canal, and can often be detected by digital examination per rectum.

The *coccygeus* is attached to the ischial spine, the adjacent pelvic fascia, and the side of the coccyx. It is in contact anteriorly with the levator ani, and posteriorly with the lesser sacro-sciatic ligament. It is supplied on its pelvic surface by the 3rd and 4th sacral nerves.

The *extraperitoneal tissue* in the pelvis, almost devoid of fat, extends along the rectum as far as the anal canal. It supports the bowel, and conveys the vessels to the rectum.

The *pelvic fascia* lines the pelvis and supplies sheaths for the muscles and supports for the pelvic viscera. Lining the levator ani on its pelvic aspect is a strong fibrous layer which at the insertion of the muscle is attached to the deep layer of the triangular ligament, the bowel wall, and behind this is continuous with the layer of the opposite side above the raphe of insertion of the levatores ani muscles, and is prolonged posteriorly over the coccygeus muscle. The rectum receives from this layer a sheath which gradually thins below and becomes lost where the anal canal commences.

Ischio-rectal fossa (Fig. 481).—This fossa, occupied by fat, is bounded externally by the pelvic fascia covering the obturator internus muscle; internally by the anal fascia clothing the levator ani and coccygeus muscles; anteriorly by the junction of the anal fascia and deep layer of the triangular ligament; posteriorly by the sacro-sciatic ligament and gluteus maximus muscle. The fossa is overlapped posteriorly by the gluteus maximus, and internally by the external sphincter; between these two the subcutaneous is continuous with the ischio-rectal fat. The depth of the fossa varies, but in an average adult measures about 2½ in. The pudic vessels and nerve run in a fascial tunnel in the outer wall of the fossa, and the inferior hæmorrhoidal vessels and nerve cross the fat in the fossa.

Arteries.—The *superior hæmorrhoidal*, a continuation of the inferior mesenteric trunk, supplies the muscular and mucous coats in the upper part and the mucosa only in the lower inch or so, one terminal vessel being found in each column of Morgagni. The *middle hæmorrhoidals* one on each side, from the internal iliac arteries, supply the muscular walls of the lower rectum and the mucosa of the upper anal canal. The *inferior hæmorrhoidals* two or three on each side, from the pudic vessels, supply the muscles principally but branches also pass to the mucosa through the interval between the two sphincter muscles or in the immediate neighbourhood. The *middle sacral* gives one or two small branches to the muscular wall, some of which may penetrate to the mucosa.

A plexus, the *hæmorrhoidal plexus*, is formed in the submucous tissue by the anastomosis of the branches of all these arteries.

Veins.—The veins are valveless. In each column of Morgagni is found a plexiform arrangement of veins, some of which may show dilatations. Leaving the upper end of each column are one or more veins which, after passing a variable distance in the submucosa, perforate the muscular wall and join the superior hæmorrhoidal vessels. When in the submucosa the veins freely communicate with one another, forming the *internal venous hæmorrhoidal plexus*.

In the perianal skin are a number of radially arranged veins, communicating with one another by a circular vein. These connect above with the radicles of the superior hæmorrhoidal veins in the columns of Morgagni. The veins of the anal margin and the anal canal chiefly contribute to the formation of the inferior hæmorrhoidal veins. Veins accompanying the middle hæmorrhoidal arteries are also present. On the outer surface of the rectal wall is a rich venous plexus contributed to by all the veins which pass out from the mucosa through the bowel wall, and hence all the hæmorrhoidal veins are brought freely into communication with one another. A free anastomosis is established, therefore, between the portal and the systemic venous circulations.

direct vision. If blood, discharge or faeces obscure the view they may be removed by cotton wool pledgets on the applicator

The introduction of the sigmoidoscope and the interpretation of the picture seen, require practice. Houston's valves may offer some impediment to its passage, but this is easily overcome by a little manipulation their appearance is too characteristic to cause confusion with a pathological condition. A little practice is required to facilitate the passage of the instrument along the sacro-coccygeal curve. Any stricture, simple or malignant or any tumour pressing upon the bowel will naturally cause some impediment to the passage of the tube. The correct interpretation of the appearance observed requires experience, and implies sigmoidoscopic familiarity with the normal rectum.

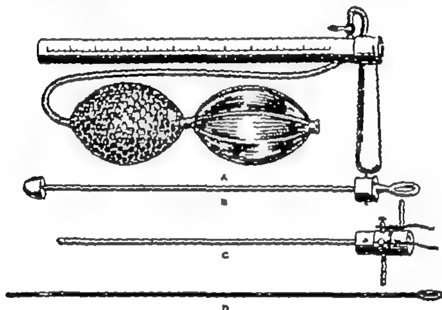


Fig. 482.—The sigmoidoscope.

A, The metal graduated tube with hand bellows attached; B, the obturator; C, the rod carrying the light at the distal end and the terminals at the proximal end D the applicator

The sigmoidoscope affords invaluable diagnostic aid in rectal lesions situated beyond the reach of the finger It is invaluable also in the diagnosis of ulcerations, high lying polypi, and malignant disease of the upper rectum. When it is used in cases of ulceration, great care must be exercised to avoid perforation of the diseased bowel wall.

MALFORMATIONS

It is impossible in the very early human embryo to differentiate the allantois and the hind gut, but as the hind-end of the embryo grows, the body-stalk, originally attached at the hind-end, becomes more ventral, as also does the termination of the allantois, so that a U-shaped bend, the *hind gut*, is formed in the dorsal part of the tube. At this stage, therefore, there is a common chamber the cloaca, into which open the hind-gut and the allantois. The opening of the hind-gut into the cloaca disappears early. As the hind-end of the embryo grows backwards, the dorsal part grows more

Lymphatics.—These, playing such an important part in cancer, are best considered in connexion with that disease (p. 733).

Anamnesis and examination.—Methodical inquiry should be made into the history of *pain hæmorrhage, discharge frequency of bowel action, the shape and size of the motions* and the presence of any *swelling* at or near the anal margin.

Pain, as distinguished from mere discomfort, is often absent in rectal diseases until some complication arises, but is usually present in lesions of the anal canal. Pain from mobility of the coccyx and pain referred from diseases of the urinary or genital tract must be differentiated from that of rectal origin. *Hæmorrhage* of rectal origin is bright red, but bright-red blood occasionally arises from disease higher in the alimentary tract. *Discharge* from disease of the anal margin is constant, whereas from the rectum it is only voided in response to the desire for defæcation. The normal *frequency of bowel action* should be ascertained, and any departure from this noted. Constipation causes some diseases, results from others. In proctitis and ulceration a characteristic spurious diarrhœa occurs; urgent calls to stool, frequently repeated, especially in the early morning, expel little but flatus, mucus, and perhaps blood; the motions may or may not be fæcal-stained, or may even contain some fæces. After expulsion of all secretion from the inflamed surface several hours of comparative comfort may ensue. The *shape of the motion* is determined by the last orifice through which it passes, i.e. the anus therefore narrowing of the lumen of the rectum does not alter the shape of the motion unless the anal sphincteric power is destroyed; stricture of the anal canal distorts the shape of the motion. Hypertrophy of the sphincter and abnormal, spasmodic action, which occur in some diseases of the anal margin, may diminish the calibre of the motion or give it a tapering extremity. In stricture of the rectum, simple or malignant, the motion consists of small isolated fragments.

Though a carefully obtained history will often suggest the correct diagnosis, visual examination of the perineum is always, and digital examination of the rectum usually necessary. *For the latter, the well lubricated finger should* be inserted very gently and slowly pressure being made away from any painful condition of the anal margin. The diagnosis of many rectal and anal diseases is possible without further examination, but visual inspection of the interior of the bowel is sometimes necessary. A *duckbill speculum* permits efficient inspection of the anal canal and lower rectum; for the upper rectum the sigmoidoscope is necessary.

The *sigmoidoscope* (Fig. 482) consists essentially of a metal cylindrical tube fitted with an obturator to facilitate its introduction, and graduated on its exterior to indicate the distance passed into the bowel. When the obturator is withdrawn, a long rod carrying a light at its distal end is introduced into the tube. The proximal end of the rod fits into the tube by a metal collar carrying the electric terminals, and closed by a glass window fitted in a metal rim. A small hand-bellows attached to the proximal end of the tube permits inflation of the rectum during examination.

The instrument, warmed and well lubricated, may be introduced with or without anæsthesia. In nervous patients, or those with painful affections, an anæsthetic is necessary. The bowels must be previously thoroughly emptied by aperients and enemata. The instrument is introduced for two or three inches, the obturator withdrawn, and the rod carrying the light introduced. The instrument should always be passed up the rectum under

direct vision. If blood, discharge, or fæces obscure the view they may be removed by cotton wool pledgets on the applicator

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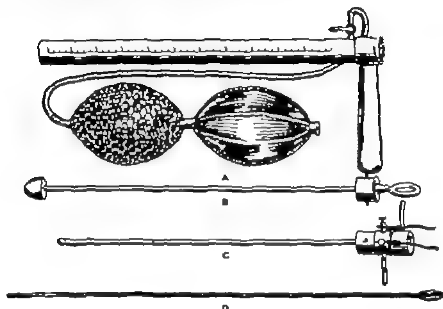


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rapidly than the ventral, and carries with it the hind-gut beyond the allantois, the *postallantoic* gut, a new formation entirely separated from the cloaca, but without an external opening at this stage. At the site of the future perineum, ventral to the termination of the postallantoic gut, the epiblast becomes thickened, constituting the *anal plug*. This thickening soon breaks down, and the *anal pit* or *proctodæum* is formed. The proctodæum meets the termination of the postallantoic gut towards its ventral surface, the two being separated by a thin membrane, which later disappears. The very short portion of the postallantoic gut dorsal and posterior to its fusion with the proctodæum disappears.

The cloaca forms no part of the rectum, but early becomes separated from it. The cloaca, receiving the openings of the genital ducts, becomes, in the male, the trigone of the bladder and the urethra to just below the openings of the genital ducts, that is, to just beyond the verumontanum. In the female, the Müllerian ducts open into the cloaca between the allantois anteriorly and the original aperture of the hind-gut posteriorly. Later the ducts migrate to the posterior part of the body and their communications with the cloaca become lost. The vagina is for a great part of fœtal life a solid structure and not a canal, but later the Müllerian ducts tunnel a passage through this to the hind-end of the embryo. The cloaca becomes the trigone of the bladder, the urethra, and the space between the labia minora.

Thus the rectum and anal canal consist of three developmental portions—(1) the hind gut, (2) the postallantoic gut, and (3) the proctodæum. The posterior limit of the body cavity serves to mark the junction of the hind-gut and the postallantoic gut. This point in the fully developed body is at the reflection of the peritoneum from the rectum to the bladder or the vagina. The posterior limit of the postallantoic gut is the level of the anal sinuses. The proctodæum forms the anal canal below this level.[1]

Keith explains the abnormalities by comparative anatomy and physiology. "Above all," he says, "the process of impregnation has to be kept in mind, for it was by the evolution of the penis that the rectum attained an opening on the perineum." The cloaca of the frog is represented in the mammal by the trigone of the bladder and the urethra; it is a passage that conveys the urine, genital products, and fæces to their destination. The fæces have no lodgment there. The rectum opens higher up than the urinary and genital ducts. Rarely in the human subject does the rectum open into the trigone of the bladder, and this exactly reproduces the amphibian form. In the tortoise and turtle the rectal orifice has moved along the dorsal wall of the cloaca nearer the tail than the genital and urinary ducts, i.e. exactly in the position where the abnormal rectum commonly ends in the human subject, in the urethra just beyond the verumontanum. The termination of the rectum as a fibrous cord on the base of the prostate represents a stage of arrest in passing from the amphibian to the tortoise form. In the tortoise and turtle the cloaca is becoming modified for sexual purposes, and is less capable of serving as a fæcal passage, and hence its orifice has moved nearer to the perineum. In Monotremes the sexual modifications are carried further, the rectum opening into that part of the cloaca derived from the ingrowth of ectoderm, the endodermal cloaca becoming the uro-genital sinus. During the evolution of the higher vertebrates the anus has migrated from an intracloacal to an extracloacal or perineal position. The various forms of malformation represent arrested stages of migration.

[1] This description follows that given by F. Wood-Jones, and is one which satisfactorily explains the various malformations.

According to Keith, both the external and internal sphincter muscles are developed from the proctodæum, which would, therefore, form the anal canal as far as the upper limit of the columns of Morgagni. Wood-Jones, however considers that the anal sinuses limit the perineal invagination. Whether the sphincter muscles are developed in the absence of the proctodæum appears not to have been determined. In two cases where the rectum ended blindly at the base of the prostate and the proctodæal invagination was not developed, but the site of the anus merely marked by a little cutaneous eminence I found a few muscle-fibres in the position and having the course of the external sphincter There was certainly no development of the internal sphincter. If the external sphincter were developed in such cases, operation might be undertaken with some prospect of success; but if it were not developed, there could be no possibility of control.

Malformations are conveniently classified according to Wood Jones's account of the development as follows —

I PERSISTENCE OF THE ORIGINAL COMMUNICATION WITH THE CLOACA

i. *Males.*—The common abnormality is the ending of the rectum in the urethra at the lower end of the verumontanum, immediately beyond the



Fig 483.



Fig 484

Fig. 483.—Rectum opening into the urethra immediately below the uterus masculinus, represented by a slight depression in the floor of the urethra.
Fig. 484.—Rectum opening into the vesicular fossa of the vulval cleft.

openings of the uterus masculinus and the vasa deferentia (Fig 483). The opening is too small to allow the passage of fæces; it seems to be provided with a sphincter The opening has been seen in the trigone of the bladder (amphibian form), at the internal meatus, and at the apex of the prostate.

Cases are also recorded in which the rectum opened into the frænum of the prepuce, the under-surface of the penis, the raphe of the scrotum or the perineum. According to Keith, "it occasionally happens that not only is the perineal orifice of the cloaca carried forwards on the outgrowing penis, but the rectal orifice is also transplanted with it."

One specimen in the Royal College of Surgeons Museum is unique (Keith) in that the rectum has two openings—(*a*) the proctodæum has grown in and opened into the rectum forming an anus in the usual position, and (*b*) the cloacal orifice has been prolonged forwards, and opens into the median raphe of the scrotum near the root of the penis.

ii. *Females.*—The commonest abnormality is where the rectum opens into the navicular fossa of the vulval cleft (Fig. 484), that is, in a position corresponding to the abnormal opening in the male subject. Some reports state that a sphincter exists at the opening.



Fig 485. — Rectum ending blindly at the back of the prostate gland.



Fig 486.—Rectum ending blindly at the upper level of the posterior fornix of the vagina.

The rectum has been seen opening into the vagina. Such cases, according to Keith s observations, are associated with a divided vagina, the arrested rectum probably preventing the fusion of the Müllerian ducts to form the vagina. In a few cases the vulva and clitoris are prolonged to form a urethra, and the rectum has been seen opening in the floor of this urethra immediately below the orifice.



Fig. 487 —Blind end of rectum attached to the prostate by a fibrous cord.



Fig 488.—Blind end of rectum attached by a fibrous cord to the posterior vaginal vault.

2. Non Development or Imperfect Development of the Postallantoic Gut

i. The postallantoic gut may be practically non-existent, the rectum ending blindly at the base of the prostate (Fig. 485) or at the upper level

of the vagina (Fig 488). A fibrous cord may attach the termination of the rectum to these viscera (Figs. 487 and 489).

II. The postallantoic gut may grow backwards imperfectly becoming separated from the prostate or the vagina (Fig. 489). It may end as a fibrous



Fig. 489.—Postallantoic gut separated from the prostate and ending blindly at some distance from the perineum, there is no development of the proctodæum.



Fig. 490.—Postallantoic gut attached to the proctodæum by a fibrous cord both the postallantoic gut and the proctodæum are imperfectly developed.

cord attached either to the proctodæal invagination (Fig. 490), or if this be not developed, to the site of the normal anus.

3. Non-Development or Ill-Development of the Proctodæum

The proctodæum and the postallantoic gut may themselves be well formed, but the original membrane separating them may partially or completely persist in the former case a fibrous stricture in the latter an absolute barrier results (Fig. 491).

The proctodæum may be very feebly developed, or there may be no depression at all. In some cases there is nothing to mark the site of the normal anus in others there is an eminence at this site.

The condition of development of the proctodæum is no measure of the degree of development of the rectum. Usually when the rectum ends in the vulva the proctodæum is absent. When the rectum ends in the prostatic urethra the proctodæum, as a rule, is absent or imperfectly developed. Generally speaking, the nearer the rectum is to the perineum the better developed is the proctodæum, but to this there are many exceptions. Conversely if a well-developed proctodæum be present, it does not always follow that the rectum is well developed.

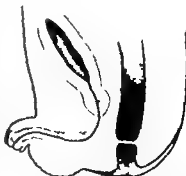


Fig. 491 —Postallantoic gut and proctodæum fully developed, but the two cavities separated by a thin membrane.

The **symptoms** depend upon the type of deformity present. When a narrowing at the junction of the postallantoic gut and proctodæum only is present, the severity of obstruction will depend upon the tightness of the stricture. The stricture may be very slight, and symptoms may be practically absent on the other hand obstinate constipation and abdominal distension may be present. Symptoms may be delayed for some time after birth in this variety (*See* Stricture of the Rectum p 717)

When there is no outlet for the meconium abdominal distension and vomiting will be present soon after birth. Rapid wasting occurs, and, if the condition be not relieved within a few days, death ensues.

When the rectum opens into the vulva the opening is often sufficient to allow the passage of meconium. Adult age has been reached with this deformity sometimes with very little inconvenience, except constipation or recurrent attacks of subacute intestinal obstruction relieved by aperients.

When the rectum opens into the urethra the outlook is far less favourable, for the opening is rarely large enough to transmit the fæces, and symptoms of intestinal obstruction in various degrees are soon evident In a few cases however life has been prolonged for three or four years, but rarely longer

Treatment.—This may be considered with reference to (1) those cases in which the intestinal canal ends blindly and there is no outlet for its contents, and (2) those in which there is an outlet in an abnormal situation

(1) Immediate relief is necessary failing which death will occur within a few days. The deformity is often overlooked through carelessness for the first day or so of the infant's life and recognised only when symptoms of intestinal obstruction appear When relief has been given by the simplest method, a considerable proportion of the infants will die even when operation is undertaken early

i. *The deformity consists of a membrane of varying thickness between the proctodæum and the rectum.*—The proctodæum is well developed, and a pronounced bulging of the rectum into it will be felt when the infant strains. All that is necessary is to incise the membrane and remove as much of it as possible. Some degree of congenital narrowing of the lumen of the bowel may be present at the site of attachment of the membrane to the bowel wall This must be overcome by the frequent passage of a finger or the bougie

ii. *The proctodæum may or may not be developed and there is no evidence to show the degree of development of the rectum.* —Two methods of procedure are possible—(a) immediate colostomy and some weeks or months later the establishment of an anus in a normal position or (b) an immediate attempt to form an

anus in the normal position by a perineal dissection In deciding between these alternatives it must be remembered that the degree of development of the proctodæum is not proportional to that of the development of the rectum which with a well-developed proctodæum may be found as high as the base of the prostate or the vagina that the only permissible method of forming the anus in the perineum is freely to separate the rectum from its connexions, and draw it to the anal margin or the skin of the future anus without tension—a dissection which, if the rectum ends high will be very difficult to execute in an infant two or three days old suffering from intestinal obstruction, and will very probably be fatal that the mere exposure and opening of the rectum allowing the contents to escape through the track thus made, will only be followed by irremediable stricture which of itself will sooner or later prove fatal that the most rapid method of giving relief should be chosen and that the immediate results of colostomy are superior to those of a primary perineal anus. As a general rule therefore, it is best to perform colostomy This should be done through as small an incision as possible in the left iliac region. The excoriation of the skin which will occur around the opening may with care be kept well under control and is probably no worse than that which occurs in the perineum when an anus is made there.

Later at a time which will vary with the condition of the child's health, an attempt is made to form a perineal anus. It may be necessary if the postallantoic gut be absent to remove the coccyx Any muscle fibres should be carefully preserved. The rectum must be separated from its surroundings (which may mean a free opening of the peritoneal cavity) and so mobilized that it may be sutured to the skin of the perineum without tension. Later the colostomy is closed. This operation, if the rectum is low in the perineum and the proctodæum (with the sphincters) is developed, may give a good result. If, on the other hand, the rectum lies high, the operation will be severe and the prognosis grave. When recovery ensues, three accidents may befall the anus (a) A stricture may occur this will not happen if the bowel, which has been brought well down and sutured to the skin, does not later recede. A stricture has probably always resulted in those cases where the bowel has been blindly opened at some depth in the perineum, and a fistulous track established between the bowel and the perineum. This is not an anus. (b) There may be deficient sphincteric control of the new anus If the proctodæum is developed and it has been possible to preserve the sphincters, then control may be obtained but in the absence of development of the proctodæum the sphincters are absent, and there will be no control (c) In some cases prolapse of the mucous membrane has occurred. This is likely to happen when there is no sphincteric closure of the anus.

(2) The treatment of this group may differ with the sex of the patient and with the severity of symptoms. In the female the opening in the vulval cleft is frequently of sufficient size to allow the escape of the *intestinal contents, it is* provided with a sphincter and the proctodæum is very frequently absent It would therefore seem best to leave things alone *Transplanting the anus from the vulva to the* perineum would merely substitute an anus in the normal position without control for the one in the abnormal position with control. If, however the aperture is too small, an anus should be made in the normal site.

In the male the condition is different, for the aperture is nearly always too small and some relief from obstruction is required. If this is not necessary in early infancy it will become so later In such cases the urgency of symptoms and age of the child will decide whether a primary colostomy or a perineal dissection should be performed.

HÆMORRHOIDS OR PILES

This term includes a variety of conditions dependent primarily in the majority of cases, upon a varicosity of the veins of the lower rectum and anal canal.

Etiology.—The condition is most common in middle life, and affects both sexes equally Although not unknown, it is very rare in childhood indeed, an instance of congenital piles is recorded It appears to be certain that there is an hereditary predisposition.

Mechanical congestion of the rectal veins is the exciting cause *and habitual constipation one of the most important etiological factors.* During normal defæcation temporary dilatation of the valveless lower rectal and anal veins is encouraged by (1) the passage of fæces through the rectum exerting pressure in a direction opposite to that of the blood flow in the ascending veins (2) the contraction of the muscular walls of the bowel tending to constrict the apertures through which the veins pass (3) the raising of the blood pressure in both the portal and caval systems during forced expiratory efforts and (4) the loss of support to the veins due to relaxation of the sphincters and levatores ani In normal subjects *no fæces should be lodged in the rectum*, but in those who suffer from habitual constipation, fæces are more or less constantly retained in the rectum, and, becoming unduly solid from absorption of water cause constant pressure on the ascending veins. The contraction of the rectal wall is increased in force and expulsive expiratory efforts are prolonged Ultimately the repeated and severe venous distension so induced terminates in permanent varicosity

Other forms of mechanical venous obstruction acting alone or in combination with constipation, are sometimes responsible for piles. The condition may be associated with local pressure by the gravid

uterus or pelvic tumours, with the general back pressure of cardiac and pulmonary diseases, and with the portal obstruction of hepatic cirrhosis, or of hepatic congestion in those who habitually eat and drink to excess.

In some cases local irritation seems to produce or to aggravate hæmorrhoids thus, etiological association has been claimed with worms in children, with fissures, ulcerations, and fistulæ, and also with diarrhœa while the mechanical results of rectal accumulations of fæces may be aided by their irritant effects in the production of piles.

Classification.—Anatomically piles are divided into *external* and *internal*. In the former the tumour is covered with skin, and in the latter with mucous membrane This is also a useful clinical classification, since the symptoms, complications, and treatment differ

EXTERNAL PILES

Several different conditions are included, some only of which satisfy the definition.

1 *Dilatation of the Anal Veins*

The veins surrounding the anal margin are dilated, and during straining form a distinct swelling when straining ceases the veins subside leaving the skin loose. The condition is always associated with constipation, and is frequently accompanied by internal piles

The **symptoms** are merely a feeling of fullness and uneasiness after defæcation. Spasmodic contraction of the sphincter may occur and in time the muscle may become hypertrophied.

Treatment should be directed to inducing regular action of the bowels. In some cases where the sphincter is greatly hypertrophied it may be carefully stretched.

2 *The Thrombotic Pile*

This term does not always indicate the true pathology It implies the formation of a thrombus in one of the anal veins. This may occur in a few cases but more commonly the prime condition is a *rupture of a vein*. The usual history is that more or less suddenly and generally during the straining effort of defæcation, there appears at the anal margin a swelling which consists of extravasated blood, fluid, tense and cystic at first, but later clotted and more firm. Should the swelling be a primary intravenous thrombosis, it is comparatively small and not cystic. Although generally single, occasionally more than one swelling may form. The tumour is tender and painful, especially during defæcation, which is therefore postponed as long as possible. Walking aggravates the pain, and sitting may be impossible.

The terminations are (1) *Resolution*. This may occur if the swell is small and irritation and constipation are prevented. Some th or four weeks are required before the blood is completely absorb (2) *Suppuration*. The clot becomes infected with pyogenetic organis and an anal abscess results (p 697) (3) The clot is *incompletely absorb* being transformed into fibrous tissue. A variety of cutaneous pile thus formed (*see* below) (4) Rarely the skin gives way the clot extruded, and a *natural cure* results.

The **treatment** *is at first symptomatic. Daily easy action* the bowels should be ensured by a mild aperient. Pain should relieved by the application of lead lotion, or sometimes hot mo applications are more gratifying. No further treatment is requi in most cases Should, however the swelling show no sign of diminis ing in a few days, the overlying skin should be anæsthetized w eucaine and incised in a direction radiating from the anal marg The clot should be expressed and the cavity allowed to heal from t bottom.

The condition is liable to recur therefore straining efforts a constipation are to be avoided

3. *Cutaneous Piles or Redundant Folds of Perianal Skin*

In appearance the folds are an exaggeration of those normal present around the anal margin In structure there is an increa of connective tissue there is also in some cases a dilatation of th anal veins, but this is by no means constant

Etiology—*As* indicated above the cutaneous pile may aris from the thrombotic one, either by the organization of the clot o by increase in the surrounding tissues due to the irritation cause by it. In other cases constipation is the prime factor Abrasio of the skin of the anal margin *by the passage of hard fæcal masse* leads to a mild infection, and therefore to some œdema of th normal rugæ the recurrence of this process induces chronic inflam matory tissue change, and therefore the formation of redundant folds. *Should the perianal veins be also dilated, these will tend to* increase the size of the folds. The enlargement of the perianal folds hinders the proper cleansing of the skin after defæcation and therefore predisposes to additional excoriation in the crevices, from which a further infection may arise. *Hence the condition, when* once established, is always liable to become aggravated

Symptoms.—A mere redundancy of the perianal folds gives rise to few symptoms. The repeated attacks of inflammation are accompanied by pain especially during defæcation and hence the patient refrains from the act as long as possible. Difficulty in thoroughly cleansing the parts after defæcation may cause pruritus ani (p 744) and

the frequent rubbing to relieve this symptom will aggravate the condition

Treatment.—The first care is to treat efficiently the constipation. After defæcation the anus should be thoroughly cleansed with water dried, and then washed with oil. A soothing ointment or powder—e.g. bismuth or zinc combined with starch—should be applied. Should this fail to relieve operative measures are indicated A general anæsthetic is necessary About two-thirds of the redundant fold is removed, leaving sufficient of the base to allow the sides to fall together Each cutaneous pile may be thus removed without fear of stricture. As in all operations in this region, complete bodily rest should be enforced until the wound has healed otherwise troublesome fissures or ulcerations may develop.

4. *The True External Pile*

In this condition there is a tumour (rarely more than one) at the anal margin It is composed of dilated veins and hypertrophied connective tissue the result of repeated irritation. Thrombosis may occur in the veins.

In the absence of acute inflammation **symptoms** are slight and are similar to those of the foregoing variety When inflammation is present acute pain and spasmodic contractions of the external sphincter render the condition very distressing Not infrequently a fissure may develop at the base of the pile.

The **treatment** in all cases is removal. Sufficient of the skin covering the base of each tumour should be retained to allow the sides to fall together so that undue contraction may be avoided.

Internal Piles

An internal pile is primarily a dilatation tortuosity and varicosity of the venous radicles of the superior hæmorrhoidal vessels situated at the base of a column of Morgagni (Fig. 492) When once established the condition tends to be progressive, and in its evolution secondary changes occur During defæcation the anal mucosa is everted and the developing pile comes within the grip of the external sphincter muscle receding after the act. This repeated protrusion causes enlargement and elongation of the pile from further dilatation of vessels, and inflammatory exudate into the submucous tissues and mucosa A definite tumour is formed, consisting of a mass of vessels, venous capillary and arterial (from the terminal branches of the superior mesenteric artery) embedded in altered submucous tissues and covered with thickened mucosa. If the condition progresses further spontaneous reduction of the protrusion may not take place, and manual reposition becomes necessary The increased irritation leads

to further thickening of the submucous and mucous tissues. If a pile is allowed to remain protruded for any length of time, it is exposed to traumatism, and may ulcerate superficially

The superior hæmorrhoidal artery divides into two primary branches, a right and a left Each of these subdivides into branches of unequal sizes. The veins correspond to the arteries. It is estimated that, should all the primary venous radicles become hæmorrhoidal, some seven, rarely eight, piles may form. The veins corresponding to the larger arterial branches are naturally the first to be affected, and there are some three or four of these. Later the smaller venous radicles

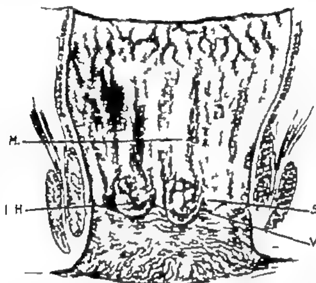


Fig 402.—Lower rectum and anal canal opened vertically and the edges held widely apart. From a preparation.

M, column of Morgagni S, sinus of Morgagni; V, anal valve; I H, internal hæmorrhoids, in the early stage, showing the pile to be an enlargement of the column of Morgagni.

dilate, and in time form piles. In most cases which come for treatment all the piles do not exhibit an equal degree of development some are completely developed, whilst others are quite small and hardly visible. The younger the patient the more probable is it that only two or three definite piles are present, but unless the etiological factor is removed the others may develop later In patients past middle life who have suffered for many years, the probability is that all the piles are fully developed.

Symptoms and signs.—The earliest symptom is *hæmorrhage* during defæcation. This occurs quite early before submucous and mucous changes have developed, and at a time when the pile is merely composed of compressible vessels and hence cannot be felt by digital

examination. The older a pile, the more thickening of submucous and mucous tissues is present and hence the less liability to hæmorrhage, unless a protruded pile is exposed to traumatism. But as piles are in varying stages of development, some fully developed with thickened mucosa, and others in an embryo state, so is the hæmorrhage variable in times of appearance and in quantity. It may be slight, merely a few drops, and disappear for weeks or months, or on the other hand it may be frequently repeated and occur apart from defæcation, and of such quantity as to cause severe secondary anæmia.

When a pile is fully developed and thickened it may be felt on digital examination as a rounded or elongated swelling, but even then it is better seen through a speculum than felt digitally.

In most cases *protrusion* of one or more piles will occur sooner or later at first only during defæcation. A repeated protrusion leads to loss of tone of the external sphincter muscle, and later the piles may protrude during any muscular exertion, or during a cough or a sneeze. No real pain is experienced in internal piles unless the protrusion becomes gripped by the tissues of the anal margin. If reduction is not immediate, superficial ulceration may occur or partial or complete sloughing of the pile may take place. Such a condition may lead to perianal suppuration.

The thickening of the submucous tissues which occurs during the growth of internal piles impairs the elasticity of the anal canal and renders defæcation difficult and creates the sensation of *imperfect emptying* of the bowel. This thickening can be detected by an experienced examining finger.

External are frequently associated with internal piles.

The **diagnosis** of internal piles is easy if a proper examination be made by means of a speculum and reflected light. If pain be excessive, probably some complication is present, e.g. a fissure or suppuration. Careful examination easily demonstrates that a protrusion consists of the mucosa of the anal canal and that it is not derived from a point higher in the bowel as is a polyp or an intussusception; moreover the pedicle of a polyp is readily felt on digital examination. Intussusception in the rectum probably does not occur in the absence of a tumour.

Treatment.—Palliative measures are indicated at first in many cases. They may suffice where bleeding is trivial, protrusion slight or absent, and the prime cause of the piles, e.g. gestation or a pelvic tumour has been removed. In old age associated with arterial degeneration, bleeding from internal piles may be regarded as favourable tending to deplete the circulation. In more than one such case, where piles have been removed, cerebral hæmorrhage has followed. In cases of chronic cardiac or pulmonary disease, or portal obstruction

operative treatment is contra-indicated. In portal obstruction, hæmorrhage relieving the portal circulation tends to prevent ascites and hæmatemesis

The first care must be to keep the bowels regular by the systematic and judicious administration of aperients. There is no one aperient which can be vaunted several may have to be tried before the one which suits the patient is found saline purgatives are generally inadvisable Undue hardness of the motion must be prevented by the injection into the bowel of warm olive oil. The diet must be regulated especially in those who habitually eat and drink excessively Alcohol is better avoided. Regular exercise should be taken. Under such treatment many cases are immensely relieved, as regards both bleeding and protrusion. Should bleeding still continue an astringent application should be employed, e.g an injection of a solution of sulphate of iron or adrenalin, a powder such as dried sulphate of iron, bismuth or zinc, a suppository containing gallic or tannic acid or an ointment, of which the principal ingredient may be one of the foregoing, or hamamelis The use, every night, of a suppository containing one grain of calomel is often valuable in restraining infective processes to which so many of the unpleasant symptoms of piles are due.

Protruded piles must be immediately replaced. They should never be allowed to remain on the chance that a cure may result from sloughing of the piles. The consequences of such treatment may be very serious. Often an anæsthetic is necessary when after stretching the sphincter the piles may be replaced.

Operative treatment should be advised when palliative measures have failed. It is indicated when bleeding is serious, when prolapse is frequent and troublesome, when there is a persistent discharge causing pruritus ani, when fissure is present, or when inflammation sloughing, or gangrene has occurred.

There are five methods of operation—(1) injection (2) the clamp and cautery (3) the ligature, (4) the excision of individual piles, and (5) the removal of a complete ring of mucosa, the so-called pile-bearing area (Whitehead's operation)

1 **Injection**—The object is to cause a thrombosis of the vessels of the pile The fluid used is commonly carbolic acid, 20 per cent. in equal parts of glycerine and water quinine-urea hydrochloride, 5-per-cent. solution, is also recommended. The pile is either drawn outside the anus, or the injection made through a speculum with the pile *in situ*. About 5 minims of the solution is injected into the centre of the pile. This causes the pile almost immediately to swell and its surface to become white When these changes have been observed the needle is withdrawn Pain following this is trivial The patient must be warned that on account of the swelling of the

pile it may protrude and should this happen it must be immediately reduced for fear of strangulation. It is generally advised not to inject more than one or two piles at one sitting. A single injection does not usually cure a pile. Injections may have to be made at weekly intervals until inspection through a speculum shows no visible pile.

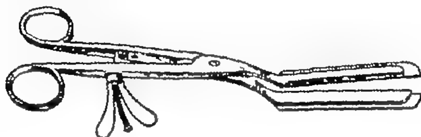


Fig 493.—Smith's clamp for internal hæmorrhoids preparatory to their cauterization.

This operation is unsuited when external piles are also present, and hence its application is very limited. It is generally held not to be curative; relapse is the rule. It requires several injections, and although they are practically painless and do not necessitate the patient's lying up the treatment is protracted. It should be reserved for those cases in which, on account of the age or general health, an operation under anæsthesia is contra-indicated or is refused.

2. Clamp and cautery.—It is claimed for this operation that the after pain is less than when other operative methods are employed, the

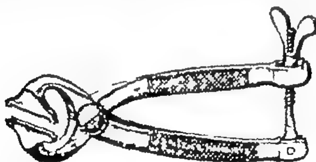


Fig 494.—Pollock's hæmorrhoidal clamp

convalescence is shortened, and there is no tendency to a contraction of the anal canal. Practical experience shows that, provided the cautery is used at a *dull*-red heat, reactionary hæmorrhage is not more frequent after this than after the other methods. The method should not be employed when external piles requiring removal are also present. It is strongly indicated where the piles are acutely inflamed, sloughing, or gangrenous, for no foreign body is left in the wound.

After dilatation of the sphincters, each pile is grasped at its base by a special clamp (Fig. 493 or Fig 494) and then seared off by the knife of a Paquelin cautery The clamp is gradually relaxed, and if any bleeding is seen the clamp should be tightened and the stump again cauterized this is repeated until all bleeding has ceased.

3 **Ligature**—This is the method which has most advocates. It can be employed in any and every case, although the cautery operation is better for sloughing piles. It deals with external piles at the same time. It should not be attended with any after-complication, and when properly performed gives very satisfactory results.

The patient undergoes the usual preparation as regards his bowels,

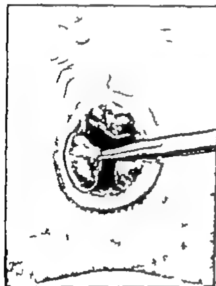


Fig 495.

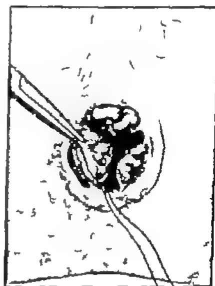


Fig 496.

The operation for removal of an internal pile. (*See* text.)

and as in all rectal operations strict cleanliness is necessary The external sphincter is gently dilated there is no need forcibly to stretch it and on no account must it be torn. The piles are everted by placing forceps on the skin at the anal margin and making gentle traction and are then grasped with forceps (Figs. 495 496) Although there may be six or seven piles present, the smaller ones can be included in the same forceps as the larger ones, and only three or four ligatures are required. V shaped incisions are made at the muco-cutaneous junction at the base of each pile, cutaneous vessels are clamped, and, if necessary ligatured, the flaps are raised and a ligature is placed around each pile as high as possible and tied very tightly the knot of the ligature being placed towards the bowel. The ligatured piles are

returned to the anal canal. It is thought better not to cut the pile off as the ligature might possibly slip, or might become loose and the pedicle, not being completely strangulated, might remain as a possible source of future trouble. Although the writer now prefers ligature without removal of the pile, many surgeons cut off the hæmorrhoid after ligating it, and then sew the cut mucous membrane over the stump of the pile.

Careful *after-treatment* is necessary. Morphia is generally required for relief of pain for 24 or 48 hours. The bowels must be kept confined for four days. Retention of urine may demand treatment. Particular attention must be paid to the cleanliness of the wounds. The gangrenous masses come away about the tenth day; after this the finger is inserted into the anal canal each day to prevent adhesion of raw surfaces. Healing does not usually occur in less than three weeks.

Sometimes œdematous tags of skin at the anal margin may appear a few days after the operation. In the healing process these generally subside. Their persistence usually indicates a faulty operative technique, and if troublesome they may have to be excised later. Stricture should never occur nor incontinence.

4. **Excision of each individual hæmorrhoid** is a modification of the ligature operation. The pile is seized longitudinally by a long narrow clamp and its upper pole, including the main vessels, is transfixed and ligatured just above the end of the clamp. The projecting hæmorrhoid is cut off, the edges of the mucous membrane are sutured with the long ends of the ligature, and the clamp is removed.

5. **Whitehead's operation** is performed as follows. An incision is made circumferentially through the skin of the anal canal immediately outside the muco-cutaneous junction. The incision is deepened until the external sphincter muscle is exposed. The mucous membrane in its entirety is dissected off the underlying structures until healthy mucosa above is reached. The diseased mucosa is removed, and the healthy cut edge is sutured to the skin of the anal margin.

Whitehead devised this operation thinking it would remove the so-called "pile-bearing area." In this he was mistaken, as piles have been known to re-form after the operation. The objections to this operation are very pronounced. Primary union of the wound seldom occurs, in spite of the greatest care; the mucosa recedes, and healing by granulation takes place. The amount of granulation tissue determines the degree of *stenosis* of the anal canal which may result. In addition, the anal mucosa is removed, hence in some cases anal sense is lost and a form of incontinence ensues. This is seen most distressingly in some patients upon whom the operation has been performed. Further, the rectal mucosa sutured to the skin of the anal margin protrudes at the anal orifice, and is exposed to traumatism, with very

unpleasant effects For these reasons the operation has deservedly fallen into disrepute and is not to be recommended.

The **complications** that may arise after operations for internal hæmorrhoids are—

(a) *Hæmorrhage*.—This occurs either from the slipping of a ligature or from an unoccluded cutaneous vessel It is evidenced by the general signs of loss of blood and the saturated condition of the dressing. It must be remembered that considerable hæmorrhage may occur into the rectum before appearing outside It is unusual, and is probably not more frequent after one method of operation than another The treatment must be prompt The patient is anæsthetized, the rectum irrigated to remove all clots, and examination made for the bleeding-point If this can be found it should be ligatured. In all probability bleeding will have ceased and all that can be done is to pass a tube to which a petticoat of lint has been tied, into the rectum and to pack gauze between the tube and the petticoat to prevent recurrence.

(b) *Infection.—Severe sepsis rarely occurs, but occasionally* especially when the operation is undertaken for inflamed or sloughing piles, some septic infection may ensue and lead to troublesome ulceration Specific infections, e.g tetanus and pyæmia, have been known to occur but they are extremely rare

(c) Temporary *loss of control* may be present after dilatation of the sphincter muscle, but is recovered from within a few hours. When the sphincter has been stretched by piles for months or years before operation, *re-establishment of muscular power may be slow In such* cases the sphincters should not be stretched more than is absolutely necessary Reference has been made to the incontinence following the Whitehead operation.

(d) *Stricture* —This should never follow the clamp-and-cautery or ligature methods of operation, if properly performed. It is one serious objection to the Whitehead operation.

Hæmorrhoids occasionally recur or more strictly speaking, fresh piles form. In young subjects *predisposed to piles, as already stated* all the possible internal piles may not be fully developed at the time of operation. If the etiological factors cannot be removed, further piles may form But after middle life this is unlikely and operation should give 100 per cent. of complete cures.

ANAL FISSURE

Definition.—An elongated narrow ulcer in the long axis of the anal canal

Etiology and pathology—Anal fissure occurs most commonly in adult life it is rare in childhood and uncommon in old

age. Chronic constipation is the usual predisposing cause. In this condition the sphincters tend to become hypertrophied and indurated and the anal canal loses its elasticity and dilatability. The fissure is at first really a tear caused by the hard scybalous mass. This is the explanation of the majority of anal fissures. Ball however thought that a fissure was often caused by a valve of Morgagni being torn and protruded during defæcation. This may account for the origin of a few fissures, and similarly a low-lying polyp may be partially detached during defæcation. The fissure in such cases is concealed by the torn valve or polyp. Rarely a foreign body may lacerate the anal margin.

A fissure is usually though not invariably single. Multiple fissures may suggest a syphilitic origin.

The great majority of fissures are situated at the posterior anal margin; rarely is the fissure at the anterior anal margin, this site however being relatively more common in the female. The lining membrane of the anal canal is least supported at the posterior margin, where the external sphincter fibres separate to surround the anal orifice; anteriorly support is slightly weaker than laterally, particularly in the female. This probably explains why the great majority of fissures are situated at the posterior margin, and why the anterior fissure is relatively more common in the female.

A fissure is somewhat pear-shaped or triangular in form, broader below than above, situated between the normal rugæ of the anal orifice and of varying length and depth. Often the upper extremity is at the lower margin of, or even overlies, the internal sphincter muscle; the lower extremity is at the lower margin of the external sphincter muscle. At first it is quite superficial, but later its base may be formed by the muscles. Often there is an œdematous tag of skin, the so-called "sentinel pile," at the lower end of the fissure and partly obscuring it. This may occasionally be an anal valve torn down during defæcation, but more often is one of the normal rugæ œdematous through infection from the fissure.

Symptoms.—Pain of a characteristic and often pathognomonic type is the one symptom. It occurs during defæcation, and lasts for a variable time after. It is often most intense, incapacitating the patient for an hour or more. It is of a tearing character and radiates from the anus to the perineum, thighs, and back. Its severity causes voluntary abstention from defæcation, with consequences disastrous to the fissure. Sometimes pain is not so severe, but passes off as soon as the bowels are relieved. The degree of pain appears to vary with the depth of the fissure. The skin of the anal canal is richly supplied with sensory nerves, some of which are probably exposed. The passage of fæces over the raw sensitive surface is responsible for the pain.

during defæcation, and the spasm of the sphincter muscle for its persistence. In some old-standing cases pain may be comparatively trivial. Reflex genito-urinary symptoms may be associated with fissure. *Hæmorrhage* during defæcation may occur this is usually a mere drop but occasionally is more excessive. A little pus is secreted *from the fissure*, and may cause pruritus ani (p 744) The spasmodic contractions of the sphincter muscle during defæcation may render the motions somewhat *flattened or tapering in shape.*

The examination must be conducted with all gentleness. On separating the circumanal folds a fissure will be readily seen. A digital examination is usually necessary to determine the presence or absence of coexisting disease. This may be impossible, even with the aid of a local anæsthetic on account of the pain induced.

Treatment.—Non-operative measures will often cure a recent and superficial fissure. Fissures of old standing with thickened sphincters, those with thickened edges, deep fissures exposing muscle, and fissures complicated by a sentinel pile require operation. Constipation must be effectually treated by senna, cascara, or aperient water *and the motion rendered as soft as possible by the injection of* oil into the bowel and paraffin by the mouth. For pain, an ointment containing cocaine, opium or belladonna etc may be applied. If these measures fail to cure in three or four weeks, operation should be earnestly advised, for this painful disease causes rapid loss of health and great depression.

Operative treatment.—It was formerly thought that the action of the sphincter muscle was entirely responsible for the persistence of the fissure. The action of this muscle is, however of very second rate *importance, and it is not necessary to divide the muscle in order to* cure a fissure. The reason why a fissure does not heal is because of inadequate drainage. The essential point is to provide adequate drainage from the beginning to the healing of the wound.

Under general anæsthesia the sphincter muscle is carefully stretched and the fissure excised with removal of the sentinel pile, if present The incision should extend outwards beyond the anal margin, so that *the wound is a flat surface and not a slit-like depression at the anal* orifice. The sphincter muscle is often exposed, but no more of this *than is absolutely necessary is incised* The resulting wound is lightly packed with gauze, and this is done, with careful cleanliness, daily until the wound is healed which may be expected in two or three weeks. Occasionally healing is tardy This may be due to unsuitable dressing of the wound locally to a faulty operation that allows insufficient drainage, or to a weakened constitutional state. Such faults must be remedied and if the general health is responsible residence in the country or at the *seaside may greatly promote a cure*

ABSCESS

Suppuration originating in disease of the rectum and anal canal occurs in definite anatomical situations. The following varieties of abscess may be distinguished, viz. (1) subcutaneous (2) ischio-rectal (3) submucous, (4) pelvi rectal and (5) labial. (*Fig* 497)

1 Subcutaneous Abscess

This is situated in the subcutaneous tissue at or near the anal margin It originates from infection of either a sebaceous follicle (the follicular abscess) a fissure or an external pile The follicular abscess is usually single, but may be multiple if more than one follicle be infected. *It is* situated close to but not at the anal margin, and has no tendency to burrow towards the anal canal hence a fistula does not follow

An abscess originating in a fissure, or in a thrombotic or inflamed external pile, is situated at the anal margin, and tends to burrow towards and open into the anal canal as well as on the surface of the skin at a variable distance from the anal margin. A complete subcutaneous fistula, therefore, frequently results. These abscesses require incision and free drainage.

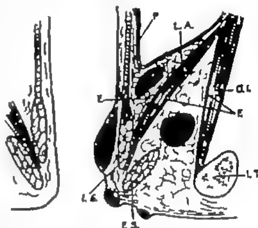


Fig 497 —Diagrammatic section, in the coronal plane, of the rectum, anal canal, and perirectal tissues illustrating the various positions of abscesses.

T Ischial tuberosity E.S., external sphincter muscle I.S. internal sphincter muscle, L. levator ani muscle; O.I., obturator internus muscle, F, fascia covering the obturator internus and levator ani muscles; peritoneum. The shaded areas represent abscesses, which are thus seen in the submucous tissue, at the anal margin, under the skin little distance from the anal margin, in the ischio-rectal fossa, and between the levator ani muscle and the peritoneum, the potential pelvi-rectal space.

2. Ischio-Rectal Abscess

The ill nourished condition of the fat of the ischio-rectal fossa predisposes it to infection. The infection may arise from any inflammatory process in the lower part of the bowel and it extends to the fossa via the weak point in the bowel wall i.e. the interval between the two sphincter muscles.

Etiology.—An inflamed internal pile an ulcer in one of the sinuses of Morgagni, *the upper extremity of an anal fissure* or ulceration following operations, may all cause an ischio-rectal abscess. But frequently none of these lesions is found, and in all probability

bacteria can escape through the bowel wall without any recognizable lesion of the latter A little accumulation of fæcal material in one of the sinuses of Morgagni may excite some inflammation from which the fossa may be infected Rarely a foreign body has been known to perforate the bowel wall, and has been found in the pus of the abscess. The bacterium causing the suppuration is either the Bacillus coli, or the common pyogenetic coccus alone or in association with the former

Suppuration tends to spread (1) towards the skin over the fossa, and towards the bowel superficially to the sphincter muscles (2) towards the bowel, usually between the two sphincters, or occasionally through the fibres of the external or internal sphincter the site of pointing or rupture being determined often by that of the origin of the infection (3) less commonly between the levator ani and the ano-coccygeal ligament posteriorly to the fossa of the opposite side (4) very rarely through the levator ani to the pelvi-rectal space (5) uncommonly to the anterior part of the perineum or labium majus.

The **symptoms** are those attending acute suppuration. A fullness in the fossa may be appreciated both externally and by digital examination of the anal canal. If allowed to progress, redness and œdema of the skin, and eventually fluctuation, will appear

Treatment.—An acute inflammatory mass in the ischio-rectal fossa should be incised at once, even before the presence of pus is certain. Early operation will materially shorten convalescence and perhaps prevent the subsequent formation of a fistula.

Under anæsthesia a curved incision is made, parallel to the anal margin over the most prominent part of the swelling and extended anteriorly and posteriorly beyond the limits of the swelling A second incision is made at right angles to this outwards, well beyond the limits of the induration. The finger is inserted into the cavity and all septa are broken down. The cutaneous margins are freely excised to enlarge the surface wound and to prevent superficial closure before deep healing occurs. Free opening is necessary to prevent the burrowing of pus, which so constantly results from any smaller incision and leads to persistent sinus or fistula. The abscess frequently heals satisfactorily under such treatment, but a sinus may persist, or a fistula form, and require further treatment this should be explained to the patient. At the time of evacuating the abscess a communication with the rectum may be present. Should this be so or if merely a thin stratum of mucosa separate the abscess from the bowel cavity the case should be treated as fistula or cutaneous sinus (p 702)

3. Submucous Abscess

An abscess in the submucosa of the lower rectum shows a marked tendency to track towards the anal margin and open there, but

also burrows to some extent laterally in the bowel wall. Usually this abscess bursts of its own accord, but if seen before this occurs it should be opened at its lower margin. Healing is generally rapid, but occasionally a submucous track persists and should be freely laid open in the longitudinal direction, care being taken to check all hæmorrhage which may be free from one of the terminal branches of the superior hæmorrhoidal artery.

4. Pelvi Rectal Abscess

This abscess, fortunately rarely met with, is a suppurative cellulitis of the connective tissue between the levator ani muscle and the peritoneum. This tissue is continuous with that between the layers of the pelvic mesocolon and the broad ligament and also with that surrounding the prostate and the neck of the bladder. Disease of the latter organs, rather than of the rectum, is frequently responsible for a pelvi rectal abscess. But occasionally ulceration of the rectum, malignant disease, or perforation by a foreign body may cause an infection of the connective tissue surrounding the bowel above the levator ani.

The ultra-acute pelvi-rectal infection frequently terminates in acute peritonitis or gangrenous cellulitis. The more subacute or chronic cases present the symptoms of pelvic cellulitis; unless rectal disease is known to exist, the cause may be entirely overlooked. Rectal examination may demonstrate a unilateral fullness above the level of the internal sphincter muscle. Pus may escape into the bowel with relief of symptoms, but drainage will probably be imperfect and the abscess refill. Sometimes the pus may track through the levator ani or posteriorly through the median raphe, to the ischio-rectal fossa, and eventually reach the surface through one or more openings. In other cases the pus may track to the iliac or lumbar regions, or even through the sacro-sciatic foramen to the buttock.

Treatment is a difficult matter and depends to some extent upon the cause. Any etiological rectal disease must be appropriately treated. Incisions into the abscess cavity must be free and may be necessary in the perineum or the iliac region or both. When a pelvi rectal abscess has burst into the ischio-rectal fossa, it is to be opened as already explained, and the aperture through the levator ani enlarged with forceps and freely drained.

5. Labial Abscess

This abscess is generally confined to the labium majus. It arises from disease of the anterior part of the lower rectum or anal canal. It is incised in a manner similar to that adopted for the ischio-rectal abscess.

FISTULA AND SINUS

A fistula is a suppurating track opening both on to the cutaneous surface and into the lumen of the bowel A *sinus* on the other hand, has only one opening, which may either be on to the cutaneous surface, the *cutaneous sinus* or into the lumen of the bowel, *the rectal sinus* Both the sinus and the fistula when of rectal origin, are practically always preceded by one or other variety of perirectal abscess. Rarely will a foreign body such as a fish-bone perforate the rectal wall without the formation of any definite abscess, causing at first a rectal sinus and later a fistula.

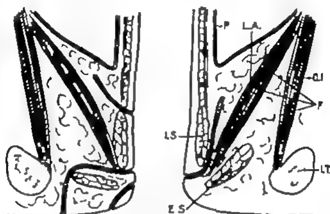


Fig 498.—Section similar to that in Fig 497 illustrating the positions of sinuses and fistulæ.

On the left side are the superficial and intermuscular fistulæ, and the internal sinus opening into the bowel above the internal sphincter muscle. On the right is the internal sinus extending into the pelvirectal space and opening into the bowel between the sphincter muscles and above the levator ani muscle. For lettering, see Fig. 497

Fistula

A fistula may be superficial intermuscular or supramuscular according to its position in the bowel wall (Fig 498)

Superficial fistula.—The track is superficial to the external sphincter or may pass between the superficial fibres of the muscle It may result from a subcutaneous abscess opening both on to the surface and into the anal canal. The internal orifice of the fistula may be seen at the base of a fissure or as a small ulcer at the anal margin. In such fistulæ the external orifice is near the anus, and the track is seldom more than 1½ in. in length Since the fistula is so superficial the discharge is slight and the inner opening being not really into the lumen of the bowel but *at the anal margin and free from the* entry of fæces, there is no tendency to the purulent accumulations and burrowing of the pus which so frequently occur in the

deeper fistulæ. The external opening is, therefore, single The internal opening of the fistula may be situated anywhere around the anus, but is very frequently located posteriorly The track may pursue a straight or slightly curved course.

In cases where perianal suppuration has been more extensive, e g an ischio-rectal abscess which has opened into the bowel superficial to the sphincters, imperfect drainage and burrowing of pus frequently lead to secondary abscesses which open spontaneously and hence multiple external openings are by no means uncommon. They may be situated in the skin over any part of the ischio-rectal fossa, or at some distance from this, in the buttocks or the perineum. Suppuration may track from one fossa to the other The external openings of a fistula may therefore be on opposite sides of the anus. The name horseshoe-shaped fistula has been given to this variety The internal orifice is commonly but not always, situated posteriorly Rarely are two internal openings present. Fistulæ superficial to the sphincter muscles are the commonest variety of fistulæ.

The **symptoms** of a superficial fistula may be slight. Pain is acute before the abscess is emptied, but is practically absent when the fistulous track is established. The discharge may be comparatively little In the more complicated fistulæ associated with burrowing of pus and abscess re-formation the symptoms are those of imperfect drainage

The **intermuscular fistula** results usually from an ischio-rectal abscess Spontaneous rupture of an ischio-rectal abscess will almost certainly lead to imperfect drainage and the pus tends to burrow in various directions, and not infrequently towards the bowel. But even when drainage is timely and efficient a fistula may form for the abscess originates from and may be in close proximity to a lesion, e.g an ulcer in the bowel, and, in fact may communicate with the interior of the bowel from the beginning or the diseased bowel wall may be readily perforated at a later date. The internal opening of the fistula is between the internal and external sphincter muscles, or in the immediate vicinity the track passing through the fibres of one or other muscle. The reasons for this fact are that the disease which originally caused the abscess is situated in this region of the bowel the sloping internal boundary of the abscess (the levator ani and its fascia) passes to the bowel between the sphincter muscles, and will direct the pus to this space the main branches of the inferior hæmorrhoidal vessels enter the bowel here and may influence the direction in which suppuration extends. The internal opening is generally single. When two internal openings are present there are either two distinct fistulæ or the second opening is higher and at the upper extremity of a submucous track, an offshoot of the original abscess. The opening is frequently situated posteriorly just to one side of the

mid line This is probably explained either by the better development of the sinuses of Morgagni posteriorly the original infection being therefore more likely to arise from this part of the bowel, or by the greater interval between the sphincters posteriorly permitting pus to track there more readily

The **symptoms** of an intermuscular fistula are various. If untreated secondary abscesses form sooner or later and are attended by the symptoms of pent up pus. Flatus, and rarely fæces, may escape from a fistula. On examination, the external orifices are readily detected. The internal orifice may generally be felt or seen, but sometimes it cannot and then without the aid of an anæsthetic the diagnosis between a fistula and a *cutaneous sinus is impossible*.

A supramuscular fistula tracks through the bowel wall above the internal sphincter muscle, and arises from rectal ulceration, pelvi-rectal abscesses, or very rarely from the burrowing of an ischiorectal abscess through the levator ani muscle with secondary rupture into the bowel The *orifices vary greatly in position not infrequently* they are multiple internally Suppuration may extend right around the bowel in the pelvi rectal space both anteriorly and posteriorly reaching the surface through many points.

Treatment of fistula.—Very rarely has a fistula been *known to heal spontaneously The walls of a short superficial fistulous* track have been seen to become completely epithelialized. Such conditions are so rare as to be ignored. Injections of stimulating lotions into the fistula have been known to produce healing, but such treatment is slow and very uncertain in results, and has nothing to commend it save in certain circumstances which render an operation inadvisable

The great obstacle to the healing of a fistula is inadequate drainage, and improvement of this can only be secured by *operation*. Of much less importance as a factor preventing healing is the movement of the muscles in contact with the fistulous track.

The ideal operation would be **excision of the tract with immediate suture aiming at primary union of the wound** This operation has frequently been practised. If successful, the time saved to the patient in the healing of the wound and the *avoidance of daily* dressings is an enormous advantage in many cases of deep fistulæ The operation has only a very limited applicability It may succeed in the very superficial and short straight fistulæ, but in these not much in time of healing is gained. In the deep tortuous fistulæ, where it would be *of great advantage*, it is extremely difficult or impossible to cleanse the wound sufficiently to obtain a primary union. The consequence often is that the superficial parts may heal but a deep track remains, and a further operation has to be done thus causing great loss of time and much annoyance to the patient. Hence the treatment

has not found favour among surgeons generally although some successes have been obtained. As the result of experiences of primary excision and suture of wounds in the Great War this method has been revived and is again on its trial, but at present cannot be said to be the method of choice.

The classical operation is **incision of the fistulous track**, providing free drainage, and leaving the wound open.

Under anæsthesia the interior of the bowel and the tracks are thoroughly examined, and it is then often discovered that a fistula is not so simple as it was thought to be from a superficial examination made beforehand.

When the track is short and more or less straight, and there are no secondary tracks a probe is passed through the fistula the tissue superficial to it are incised (or in some cases, if too much tissue has not to be sacrificed, it may be advantageous to excise the track) granulation tissue is thoroughly curetted and, what is very important in the treatment of all fistulous tracks, the edges are cut away so as to leave a freely open wound and not a slit which is so liable to cover superficially before the deeper parts are healed.

In the more extensive fistulæ and the horseshoe-shaped variety all the external tracks are slit up first and then the track communicating with the bowel is incised. As before septic granulation tissue is scraped away and the overhanging edges are freely removed so as to leave a comparatively large wound, which must heal firmly from the depths, so that no possibility of superficial bridging is allowed to occur. The incision into the bowel should be very carefully planned in a direction radially to the margin so as to leave a good scar. As stated, the opening into the bowel is nearly always single. If two internal openings be found it is better to incise the tracks through the bowel at different operations. When the internal opening is above the external sphincter the muscle when necessary must be cleanly divided in a radial direction. When this opening is situated laterally it must always be borne in mind that the division of the external sphincter may in some cases, result in incontinence and before it is undertaken one should seriously consider whether it would not be advisable in the first instance freely to drain the tracks, giving the fistula a chance of healing without division of the sphincter and reserving the division of the muscle for a second operation if the former has been unsuccessful in obtaining healing. All deep tracks running up the side of the bowel wall should be freely dilated and drained. Any dense scar tissue surrounding the tracks should be incised in several places to allow of better healing. Difficulty in finding the internal opening may be overcome by injecting methylene-blue along the track.

The treatment of the *supramuscular fistula* often presents great difficulty It depends to a large extent upon the original disease causing it. Free drainage to the internal opening must be established. The division of both sphincter muscles has been done with complete success, but it has often ended in incontinence, and hence should always be avoided when possible and reserved for those cases in which free drainage has failed to cure, and previous operations have reduced the condition to a single track which refused to heal on account of its communication with the bowel. The risk of incontinence should be explained to the patient.

The *after-treatment* of fistula operations is of great importance. Most careful attention must be paid to surgical cleanliness and dressings, so that adequate drainage is maintained throughout the course of healing. Convalescence in the more complicated fistulæ is often prolonged and constitutional treatment must not be neglected.

For the treatment of tuberculous fistulæ, *see* p 709

SINUS

The **cutaneous sinus** results from an anal abscess, an ischio-rectal abscess, or occasionally from a pelvi rectal abscess, reaching the surface through the levator ani and ischio-rectal fossa. The imperfect drainage of the sinus, and, to a much less extent, the constant movements to which it is subjected by the action of the sphincter muscles, are factors which tend to prevent healing.

The differentiation between a cutaneous sinus and a fistula is often difficult, and requires patience and manipulative skill Inability to pass a probe through the sinus into the bowel does not necessarily mean that no communication exists. The passage of fæces or flatus through the track or the discovery of an internal opening, establishes the *diagnosis of fistula*.

The treatment of a cutaneous sinus is essentially the provision of free drainage. It must be freely opened up scraped, and overhanging edges removed. When the track passes close to the bowel superficial to the sphincters and it is certain that there is no aperture of communication with the bowel, one may be made by passing the probe through, thus converting the sinus into a fistula as such it is then treated. Should, however the track pass close to the bowel above the level of the sphincter muscle, the danger of dividing these muscles has already been mentioned, and it should not be done unless other measures fail to produce healing

In the **rectal sinus** the aperture of communication with the bowel may be situated superficially or between the two sphincter muscles, or in close proximity or less frequently above the level of the internal sphincter muscle. The *rectal sinus results* from the

rupture of an abscess into the bowel. Drainage is nearly always inefficient the orifice into the bowel frequently becomes temporarily occluded and pus reaccumulates. The **symptoms** are those of recurring attacks of perirectal suppuration with periodical discharges of pus from the bowel On examination an induration may be felt outside the bowel wall, more evident at some times than at others. With a speculum the internal orifice may be seen, and pus observed to issue from it.

Cure cannot be expected without operation since the drainage from the abscess into the bowel is always inefficient.

Treatment.—(a) When the internal orifice is superficial it is exposed, a probe passed through towards the surface and cut down upon and the sinus converted into a fistula and treated as such. (b) *When the orifice is above the external sphincter muscle* the operation performed as above would necessarily divide the muscle, and incontinence of fæces might probably result. The abscess should be incised from the surface, efficient drainage provided and the track through he bowel wall treated as for a fistula in this region (p 704)

COMPLICATED FISTULÆ

Under this heading are included some of the rarer forms of rectal fistulæ Two varieties may be considered (1) the fistula communicating with some adjacent viscus—the bladder the urethra or the vagina and (2) the fistula dependent originally upon some chronic bone disease.

1 (a) **Recto-vesical fistula.**—This may be caused by rectal ulceration spreading to the bladder by a pelvi-rectal abscess opening both into the bowel and the bladder or more rarely by injuries, such as bullet wounds or buffer crushes.

The typical **symptoms** of a recto-vesical fistula are those caused by the escape of the contents of one viscus into the other Urine may pass into the rectum, or fæces into the bladder and theoretically it would seem that both may occur Practically however a valve-like action develops, and the current is only in one direction. Severe cystitis and the presence of fæces in the bladder cause extreme suffering and painful micturition. Excoriation in the anal region may occur from the constant passage over the skin of urine

The **treatment** varies with the cause of the fistula If this is due to malignant disease and fæces are entering the bladder a palliative colostomy is indicated, though the less distressing symptoms of urine escaping into the bowel will not, of course be relieved. Cystostomy may be necessary in some cases where micturition is extremely painful. When the fistula is narrow and of inflammatory origin, success has attended cauterization through a long rectal speculum with or without a preliminary posterior proctotomy When this fails or when the

orifice is large, cure can only be obtained by perineal dissection, separating the rectum from the prostate and bladder paring the edges and suturing them. The operation is severe and difficult, and often attended with failure.

(b) **Recto-urethral fistula** *usually results from urethral disease* (e.g a stricture) and very rarely from penetrating wounds. The symptoms are those of the original urethral disease and the passage of urine into the bowel during micturition. The treatment is, in the first place, that of the original disease A stricture should be dilated and the urine drawn off by catheter This simple measure may be successful. If it fail, the fistula should be exposed by a dissection *from the perineum, and the apertures closed with sutures.*

(c) **Recto-vaginal fistula** may be due to any form of perirectal suppuration which opens both into the bowel and the vagina to injuries during parturition or caused by operations, to tuberculous or syphilitic infection of either the bowel or the vagina or both, and also to cancer originating in either viscus. The symptoms peculiar to a recto-vaginal fistula are the passage of flatus and fæces from the *bowel to the vagina. The treatment of the fistula obviously depends* upon the cause. If due to malignant ulceration the disease in all probability will be too extensive for removal, and a palliative colostomy is indicated. Syphilitic and tuberculous disease must be appropriately treated before any attempt is made to close the fistula. When the aperture is of small size, cauterization may effect a cure. In other cases the edges of the fistula may be pared and sutured either from the vagina or from the rectum as the one or the other may seem the more accessible. In yet other cases the fistula may be exposed by a perineal dissection, the edges of the openings pared, and approximated by sutures. A recto-vaginal fistula has been successfully treated by abdominal section, exposure of the fistula, separation of the rectum and vagina, *and closure of the aperture in each organ.*

2. **Fistula dependent upon bone disease.**—Abscesses arising from bone disease occasionally open into the rectum. A psoas abscess which enters the pelvis by perforating the sheath of the muscle, an abscess originating from the sacrum or ischium or perhaps more frequently an abscess due to coccygeal caries, are examples of those which may communicate with the rectum. The diagnosis is usually *easy from* the history of the case and the clinical examination. Radiography may when necessary aid the diagnosis of bone disease. The treatment of these fistulæ is that of the original bone disease.

Coccygeal Sinus

Reference to this rare condition seems necessary because of its clinical likeness to rectal disease.

Bland Sutton has called attention to sinuses over the apex of the coccyx which are similar to postanal dimples and are due to a faulty coalescence of the cutaneous covering of the back These recesses are lined with skin furnished with hairs sebaceous and sweat glands.

These although congenital often do not cause trouble until later in life. Some inflammation either from friction or from accumulation of dirt in the track occurs, suppuration follows, and a sinus of varying length forms. The sinus never opens into the rectum, the aperture is generally single and situated near the apex of the coccyx. The track rarely passes to the front of the coccyx.

The **treatment** is complete excision of the track and any secondary sinuses which may have formed

INFLAMMATION—PROCTITIS

Much remains to be learnt about the bacteriology of proctitis and the classification adopted is clinical rather than pathological. For clinical purposes proctitis may be considered under the heads of Simple Catarrhal Proctitis, Gangrenous Proctitis, Proctitis due to Specific Organisms, and Ulcerations.

Catarrhal Proctitis

Acute catarrhal proctitis may be caused by injury by foreign bodies in the rectum, by the irritation of scybalous masses, by violent purgatives and other drugs, by threadworms, or it may be a specific bacterial infection of whose nature we are ignorant.

The **symptoms** are rectal tenesmus and the passage of muco-pus tinged with blood The mucosa is very swollen and vascular The frequent straining at defæcation renders the swollen mucosa liable to prolapse Reflex urinary symptoms are frequently present.

The course and terminations are various. Some cases resolve in a few days, others become chronic and occasionally ulceration follows.

Chronic catarrhal proctitis may follow the acute form, or may be insidious from the beginning, and of unknown nature. The **symptoms** are similar but modified in degree. The rectal mucosa is swollen pale and œdematous, and covered with tenacious muco-pus. Cell proliferation in the submucous tissue may lead to considerable thickening of the rectal wall. Superficial ulceration may be present. In some cases there is marked œdema of the mucosa which bulges into the bowel wall. In others the mucosa is very vascular and spongy and hæmorrhage is the predominating symptom.

Treatment.—In the acute form, rest in bed, a diet which leaves the least residue and regulation of the bowels with mild aperients are essential Occasional hot hip-baths afford relief and astringent injections and sedative suppositories should be given. When the

disease has become chronic similar treatment is necessary and the rectum should be irrigated with some astringent lotion through a double-channelled catheter or better a direct application of silver nitrate argyrol protargol, or iodine should be made to the diseased mucosa. Cataphoresis may cure some cases (see p 715)

Diffuse Septic and Gangrenous Proctitis

This is, nowadays, a very rare condition Formerly it was seen after operations upon the rectum, and was apparently infectious. The infective process involved the rectum and the perirectal tissues, and was not infrequently fatal. If recovery took place, it only did so after prolonged suppuration and sloughing, leaving the tissues permanently damaged, e.g by strictures of the bowel and destruction of the *sphincter muscles*.

Proctitis due to Specific Organisms

Gonorrhœal proctitis is rare. It occurs more frequently in the female by direct infection from the vagina in the male it results from unnatural coitus The symptoms are those of catarrhal proctitis The diagnosis is founded upon the bacteriological examination. The treatment is similar in the acute stage to that of catarrhal proctitis. When the disease has become chronic douches of protargol, chinosol, or some mercurial lotion should be employed, or a direct application of one of these substances should be made to the diseased mucosa.

Diphtheria very rarely attacks the rectum and anal canal. Occasionally it has been seen in association with the disease in the throat, and it is said that the lesions in the perineum have preceded those in the more common situations. It is also stated that diphtheria has followed an operation in this region. The signs, diagnosis, and treatment are similar to those of the disease in the usual situations.

Tuberculosis is not uncommon, and is usually secondary to pulmonary disease. It is stated however that the lesion may be primary the bacilli entering with the food Imperfect gastric digestion may permit the passage of undestroyed bacilli, which may lodge in the anal sinuses and there cause single or multiple *tuberculous ulcers*. The ulcer is small and shows no tendency to spread widely over the surface of the bowel though it is very apt to perforate to the perirectal tissues Usually the first indication of the disease is a slowly *forming ischio-rectal abscess*, which differs from the acute abscess already described in its slower development and less severe symptoms. The abscess tends to burrow in the fossa eventually making its way to the surface and discharging through one or more openings which show the undermined edges and bluish discoloration of the surrounding

skin and the prominent pale granulations characteristic of tuberculous sinuses.

Clinically the tuberculous fistula may generally be differentiated by the following points The buttocks are thin and the ischio-rectal fossæ feebly developed the perineal hair is abundant long and silky the abscess preceding the fistula forms insidiously the external orifice is more or less characteristic of a tuberculous sinus, the discharge is thin and watery and the internal opening is often easily felt and seen being sometimes so large as to admit the finger tip. It can only be certainly diagnosed by finding the tubercle bacillus in the discharge or by the microscopy of the granulation tissue lining the sinus.

For treatment the subjects of tuberculous fistula may be divided into three classes

(a) *Fistula associated with advanced pulmonary tuberculosis*.—As little should be done as is consistent with relief of symptoms. If the abscess has not burst externally but a rectal sinus is present, considerable pain may be caused by the passage of fæces into and the accumulation of pus in the cavity Under local anæsthesia external drainage should be provided. No active interference should be considered if free drainage is already established.

(b) *Fistula associated with chronic tuberculosis*.—In the majority of these cases an attempt may be made to cure the fistula and with considerable prospect of success.

(c) *Fistula not associated with pulmonary tuberculosis*.—In these cases there is a liability to the later development of pulmonary tuberculosis. Every endeavour should be made to cure the fistula. All the tracks should be slit up and their walls scraped, or in some cases the whole track may be dissected out. The communication with the bowel should be laid open. The wound may be partially closed by sutures, and primary union in part may be anticipated.

Of greater rarity than the above is the variety in which *the tubercles are deposited irregularly in the mucous or submucous tissues of the bowel wall* (Fig 499) These degenerate, and finally *ulceration* ensues. The tuberculous ulcer may be seen on any part of the rectal wall. At first it is superficial with thin undermined edges, and on its floor may perhaps be seen caseating areas. The surrounding mucosa becomes much swollen and probably shows yellowish areas of caseating tubercle. Adjacent ulcers will coalesce until a considerable part of the rectal wall is involved indeed, in some advanced cases almost the entire rectum may be invaded. The ulceration may spread to the anal canal and destroy the sphincters. The depth of a tuberculous ulcer is very variable. If it is allowed to progress the muscular wall may become eroded, the peritoneum involved, or

suppuration may occur in the pelvi rectal space or in the ischio rectal fossa.

The symptoms are those of ulceration of the rectum, described on p. 713 The condition has to be diagnosed from chronic septic ulceration, syphilis and malignant disease. In a great majority of cases pulmonary tuberculosis is present Diagnosis is only established by the examination of the granulation tissue or the discovery of the tubercle bacillus in the scrapings of the ulcer The latter is generally an easy matter in this form of ulceration. The course of the disease varies. Since pulmonary tuberculosis is usually present the rectal ulceration tends to progress even when treated. In a few cases, under treatment the disease runs a more chronic course fibrosis occurs, and in part the ulceration may heal.

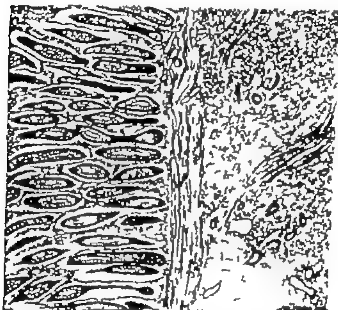


Fig 499 —Section, taken near the edge of the ulcer from a case of extensive tuberculous ulceration of the rectum, showing the submucous tuberculous *infiltration*.

Although tuberculous disease is often given as a rare cause of rectal *stricture*, the evidence is by no means conclusive that the healing of a deep tuberculous ulcer ever progresses sufficiently to narrow the lumen materially

The treatment of tuberculous ulceration of the rectum depends upon the severity of the pulmonary affection and the extent of the ulceration. In advanced pulmonary disease very little can be done except by astringent injections to relieve the distress caused by the constant discharge If the pulmonary affection permits of any operative procedure and the ulcer is of only moderate size it may be excised. If larger the ulcer should be thoroughly scraped and the raw surface cauterized or smeared with pure carbolic acid, and dusted with iodoform powder This may have to be repeated should the ulceration

spread, or a fresh ulcer arise. When the disease is extensive the only method of cure is by complete excision of the rectum This, in the great majority of cases is not permissible on account of the pulmonary affection. Perirectal suppuration must be treated as already described.

A third variety of tuberculous disease occurs in which *the inflammation is limited to the skin of the anal canal and the immediate perianal region.* Excluding the cutaneous affection which occurs around the orifices of tuberculous fistulæ tuberculosis of the anal skin is very rare. The disease is very chronic, involves the anal canal, but does not tend to spread to the mucosa The appearance resembles that of hypertrophic lupus. The bacilli are difficult of detection in this lesion, but the microscopic structure of the granuloma is characteristic The affected area of skin should be removed.

Syphilis.—Various syphilitic lesions occur in the rectum and anal canal. The primary chancre has been observed rarely at the anal margin, and even on the rectal mucosa. In the secondary period moist papules and condylomata are met with at the anal margin, and may extend into the anal canal multiple fissures similar to those in the lips and tongue appear at the anal margin, and mucous tubercles have been seen on the rectal mucosa. It is said that in the tertiary period, multiple localized gummata and diffuse gummatous infiltration may occur in the submucosa and spread deeply into the muscular walls. Ulceration may follow and the coalescence of several large ulcers may cause wide and irregular tissue destruction. A gummatous ulcer has been said to have invaded neighbouring parts, e.g the bladder and vagina, and fistulæ may occur between these viscera. Although it has been customary to assign to tertiary syphilis a prominent place in the etiology of chronic rectal ulceration, proctologists of wide experience in this country although not denying its occurrence, are unfamiliar with it. Prof. Hartmann, on the other hand, considers syphilis a very common cause of stricture of the rectum.

There is a decidedly rare form of diffuse gummatous infiltration called by Fournier the ano-rectal syphiloma" Commencing in the submucous tissue, it involves a considerable part of the rectal wall, with or without implication of the anal canal. Ulceration may or may not ensue. The bowel wall is converted into a rigid and much thickened tube which later becomes diminished in size by fibrous contraction. It appears to be analogous to the diffuse syphilitic deposit met with in other viscera, e g the liver and testicles. Anti syphilitic treatment in the early stage gives good results, but later when fibrosis has supervened, is of little value

Chancroids (*see* Vol. I., p 869) occur on the skin in the vicinity of the anus. They are much more common in the female,

and arise by direct infection from the vulval discharge. The sores are multiple, and in appearance prognosis and treatment are similar to those occurring on the genitals Occasionally the ulcerating chancroid may extend into the rectum. According to some this is one cause of chronic ulceration of the rectum, but it must be decidedly rare.



Fig. 500.—Extensive ulceration of the rectum, reaching from the anus (which is surrounded with piles) to some 6 inches above. The walls of the bowel are considerably thickened, and several perforations are seen. The cause was supposed to be syphilis.

Dysentery.—Many different forms of rectal ulceration have been ascribed to dysentery but the term should be reserved for cases caused by the organisms of tropical dysentery The rectum may be involved in true dysentery but probably only in association with disease in the colon The ulcerations are then superficial, and in their healing give rise to but little contraction. It is stated however that occasionally a stricture productive of symptoms may follow

Actinomycosis may very rarely occur in the perianal skin and in the anal canal.

ULCERATION (Figs. 500 601)

Septic ulceration of rectal sinuses.—When well developed the sinuses *peculiarly* lend themselves to the lodgment of fæcal material which may cause abrasions and open the path for septic infection. Though occasionally two or more may be present the ulcer is usually single situated dorsally and may

be as large as a threepenny piece Symptoms may be absent but sometimes pain radiating around the perineum and down the thighs is present without any relation to defæcation it differs from that of a fissure since the ulcer is above the level of the external sphincter muscle Sometimes there are traces of blood and pus in the motions and pruritus ani may be present Discovery of an ulcer in a sinus, concealed by a swollen valve may be difficult without anæsthesia hence a faulty diagnosis of rectal neuralgia has been made in some cases. An ulcer in the sinus may cause infection in the ischio-rectal fossa and possibly may rarely be the starting-point of chronic diffuse ulceration



Fig 501 —Extensive ulceration of the rectum, of unknown origin.

Ulceration caused by injuries. —Accidental wounds of the rectum are rare but may initiate chronic diffuse ulceration. Ulceration has followed injury with the stem of an enema tube and also wounds made for the removal of hæmorrhoids, etc thus postoperative danger is enhanced if the patient is feeble and resumes the upright posture before the wound has healed. Some authorities consider that erosions of the mucosa by hard scybalous masses may be a possible starting-point of a progressive ulceration Portions of the rectal wall may be so severely damaged by the passage of the fœtal head during labour that an infective gangrene may ensue In such cases large portions of the mucosa or even the deeper parts of the bowel wall may slough. This damage done by the fœtal head is held by some to be a cause of chronic septic ulceration, and in this way it is sought to explain the greater frequency of ulceration in the female sex.

Follicular ulceration is rare. Numerous ulcers, more or less circular and with sharply cut edges, involve the whole thickness of the mucosa, and may be associated with a similar condition throughout almost the entire colon. In some cases the condition seems to have a relationship to chronic renal disease. It probably plays no part in the etiology of chronic rectal ulceration.

Chronic diffuse ulceration.—Excluding tuberculous disease, where the diagnosis is made upon bacteriological or pathological grounds most cases of chronic diffuse ulceration are of obscure origin. Whatever be the prime cause, the common organisms of suppuration, viz. streptococci staphylococci, and the Bacillus coli are in great part responsible for the spread and chronicity of the ulceration. Hence it is that some put forward syphilis as a primary cause, others maintain that chancroid is more often responsible than syphilis, some think that gonorrhœa may be the initial lesion and others maintain with very good reason that some form of injury particularly injury to the rectal wall during labour is the most important cause It is certain that women are more often affected than men, and reference to some of these causes will show how much more frequently the female sex is predisposed.

Symptoms of chronic diffuse ulceration.—Whatever the cause the symptoms are characteristic The accumulation of the discharges in the lower bowel creates a frequent reflex desire to defæcate. Since the lower bowel contains scarcely any fæcal material, little but flatus, mucus, pus, and perhaps blood, is passed. This frequency of defæcation is particularly present in the early morning immediately the patient assumes the upright position, or at any other time during the day after resting for a while. The remainder of the day the patient may spend in comparative comfort But as the ulceration progresses and the discharges become more copious the desire to go to stool will be felt more and more frequently during the day until it may be that a call must be answered every hour The quantity of pus and blood passed will vary considerably depending upon the extent and depth of the ulceration. Pain is not a marked feature in the early stages but later some pain in the perineum, in the back, or radiating down the thighs is very common Reflex urinary symptoms may be present.

A progressive loss of weight and strength due to the continual discharges, the loss of appetite and insufficiency of food and the unhealthy life which has to be led by these sufferers, will certainly be present sooner or later In a considerable number of cases some narrowing of the lumen of the bowel will occur and the symptoms of chronic intestinal obstruction will add to the suffering and mal nutrition of the patient. Perirectal suppuration is common. Distant

foci of inflammation particularly involving the joints not in-quently occur as they may in any infective disease

The ulceration in some cases extends to the pelvic colon and ov this viscus pain may be experienced and tenderness elicited T pelvic and iliac colons may be felt as thickened cylinders Plast peritonitis may be present, and localized suppuration or diffus peritonitis may occur either from perforation of an ulcer or migration of the bacteria through the unhealthy bowel wall.

On examination with the sigmoidoscope the diagnosis of ulceration is easy but the cause often remains undetermined. The sigmoidoscope may fail to demonstrate the upper limit of the disease either because its passage is prevented by a stricture or because its length is insufficient. In such cases the extent of bowel involvement can only be decided by abdominal exploration.

Treatment of ulceration of the rectum and anal canal.—This depends to a slight extent upon the cause, but far more upon the situation and extent of the ulceration. If it be due to a specific organism the recognized treatment of this, either by drugs or by vaccines, is indicated Such cases form a small minority for when cases are first seen the ulceration has become chronic and is in great part dependent upon the common pyogenetic bacteria the infection is a mixed one and vaccines are probably useless. In all cases absolute rest in bed is essential the diet should be very light and calculated to leave the smallest possible residue and the bowels should be carefully regulated by aperients to prevent accumulation of fæcal material in the rectum.

When the ulceration involves the anal canal only or at the most the lower rectum, the sphincters are to be stretched under anæsthesia, and some application made direct to the ulcerated surface Nitric acid carbolic acid, or other strong caustic may be applied. Or the ulcer may be curetted and covered with some antiseptic powder such as iodoform. Hot hip-baths and enemata containing some antiseptic such as weak creolin or chinosol, should be given daily The application of the caustic will sometimes have to be repeated. Such treatment may succeed in early cases where ulceration is of very limited extent

When, however the ulceration is higher in the bowel, but still of limited extent similar treatment may be employed but is very often attended with complete failure In fact rectal ulceration which is at all extensive and long-continued is very rarely cured by enemata or direct applications.

Zinc cataphoresis.—The principle of this treatment according to Ironside Bruce "is that zinc sulphate is broken up by the galvanic current the zinc ions travel towards the negative pole and are thus

driven into the tissues surrounding the positive pole. The SO_4 so liberated combines with the metallic zinc of the positive pole to form again zinc sulphate. The method of application is exceedingly simple. The necessary apparatus is as follows A zinc rod, 6 in. in length, with suitable connexion at the end for the purpose of attaching it to the positive pole of a galvanic supply a large indifferent electrode to connect the negative pole. The zinc rod is covered with four layers of lint which is saturated with a 4-per-cent. solution of zinc sulphate (in distilled water) The negative electrode is soaked in plain water to ensure a good contact. The patient being suitably placed lying on the side, with the aid of a little vaseline as a lubricant the positive pole is introduced in the rectum to a distance well above the ulcerated area. The indifferent electrode is placed over the sacrum or on the abdomen to this is attached the negative pole of the source of the galvanic current, the positive pole being attached to the zinc rod. It is necessary to have a milliamperemeter in circuit. All connexions having been made secure, the circuit is completed, and the resistance cut out until the meter stands at 20 ma In one or two minutes the amount of current will increase to 25–30 ma., and it is kept at this figure for ten minutes. Such an application is made once every two weeks. This method is quite sufficient where the ulceration is confined to the lower portion of the bowel but where the disease extends higher up slightly more complicated apparatus is necessary"

This treatment seems worthy of a thorough trial. Should it fail operative measures have to be considered.

Excision of the diseased bowel would seem to be the ideal method of treatment. Superficial ulcers of comparatively small size may be excised and the margins of the mucosa sutured. If the ulceration is superficial and involves only the anal canal or at most the lower inch of the rectum it may be possible to excise the diseased mucosa—Whitehead s operation (p 693) This operation has, however a very limited sphere of practicability as ulceration in this region generally responds to more simple methods of treatment. It must be insisted that all the diseased mucosa should be removed and healthy mucosa sutured to the skin of the anal margin. The objections to Whitehead s operation have been given (p 693), but should some anal stricture or some incontinence result, if healing can be obtained, the condition of the patient may be improved by this operation.

When ulceration involves the higher bowel and extends more deeply the rectum in whole or in part may be excised by a method similar to that for excision of a cancerous rectum save that the perirectal tissues need not be removed (p 741) Excision is only practicable when the whole diseased area can be removed. It is contra indicated when perirectal suppuration, sinuses, and fistulæ are present. At all

times it is a serious operation, and one not to be lightly undertaken. Its severity is increased in the enfeebled subjects of chronic ulceration and the difficulties of the operation are magnified by the perirectal infiltration which is often present. Rarely therefore, can excision in these cases be performed.

Colostomy is merely a palliative operation, whose object, by diverting the passage of fæces, is to give entire rest to the diseased bowel. It is the only procedure in many cases where perirectal suppuration, sinuses, and fistulæ are present. Where excision is impossible, either from the general condition of the patient or upon anatomical grounds, and where simpler forms of treatment have failed to alleviate symptoms, colostomy is indicated. There will naturally be considerable aversion on the part of the patient to the operation, but his condition is often enormously improved by it, and his life rendered more tolerable. Following the operation, energetic treatment locally must be persevered with. The bowel must be thoroughly cleansed, and this may be more effectually done through the colostomy opening than from the anus. Should the ulceration heal, certainly some degree of stricture will result. If this can be effectually treated (p. 719) it may be possible to close the colostomy opening. More often the colostomy must remain permanently for when the ulceration has been so extensive, in the healing process the bowel becomes so deformed that the satisfactory treatment of the stricture is impossible, and its covering is so delicate that ulceration is liable to recur upon the slightest provocation.

STRICTURE

The lumen of the rectum may be narrowed by extrinsic causes, e.g. enlargements of the prostate, pelvic cellulitis, uterine tumours, hydatid cysts of the pelvis, neoplasms of the sacrum, etc. which are all described in their appropriate places. A stricture implies that the narrowing is produced by some abnormality or pathological change in the bowel wall itself.

A stricture may be (1) *congenital* (p. 681) (2) *spasmodic* (3) the result of *inflammatory changes in the bowel wall*. Congenital stricture is not very common. If of slight degree it may pass unnoticed in infancy and symptoms may not occur until later life. If the infant is born with atresia operated upon, and survives, some degree of stricture results, its severity depending upon the extent of malformation. The stricture is situated in the anal canal or at its junction with the rectum. Spasmodic stricture is extremely rare but cases of pure muscular spasm have been recorded. Inflammatory changes in the bowel wall may narrow the lumen in one of two ways—(a) by a diffuse mucous, submucous, and muscular infiltration, such as may occur in

some forms of proctitis, the diffuse ano-rectal syphiloma (p. 711) and to some extent in diffuse tuberculosis of the bowel (p. 709) (b) much more commonly by the fibrous contraction which necessarily results from the healing of any deep and extensive ulceration (p. 714) Diffuse inflammatory infiltration and fibroid contraction may occur together

The **pathological appearances** depend upon the cause. Congenital strictures are felt by the finger as a tight ring postoperative strictures in the anal canal are felt as a fibrous ring surrounding the lumen of the bowel in such cases there may be deep infiltration of the bowel walls. Where fibrous contraction results from the healing of rectal ulceration the degree and extent of the stricture will vary enormously In the majority of cases which come under observation active ulceration is still present. The stricture is usually within reach of the examining finger but occasionally it is higher and may be at the junction of the rectum and the pelvic colon It is sometimes annular surrounding the lumen as a fibrous ring in other cases the contraction takes place on one side only with the result that the wall is puckered up at this site again, in others a considerable extent of the bowel is involved in the contraction. Polypoid masses of infiltrated mucous and submucous tissue may be seen projecting into the rectum. Hæmorrhoids frequently accompany a stricture, and are probably caused by the pressure upon the hæmorrhoidal veins. The bowel above the stricture becomes hypertrophied and dilated. *Fæcal masses retained above a stricture will cause ulceration or aggravate that already existing*

Symptoms.—Most commonly the symptoms of stricture are slowly engrafted upon those of ulceration. The passage of fæces becomes increasingly difficult they are retained above the stricture for a variable time, and then expelled piecemeal, so that the motion consists of small, hard, isolated fragments. There are periods of days together when no motion may be passed. If the stricture is low down near the anal margin e.g the congenital stricture, or that following operations upon the anal canal interfering with the action of the sphincters, the motion may sometimes be flattened or ribbon-shaped or reduced in calibre Since ulceration is so commonly present, the passage of blood, pus, and mucus is more or less constant. Even if ulceration be absent, the irritation of fæces retained above the stricture will excite a catarrh of the bowel shown by the passage of mucus, and perhaps blood. The patients complain of diarrhœa —the spurious diarrhœa of proctitis or ulceration. Sooner or later *symptoms of intestinal obstruction* appear—i.e. flatulent distension, probably aggravated by food unpleasant rumblings of wind in the bowels, accompanied by colicky peristaltic pains and an increasing demand for purgatives to obtain an action of the bowels. Later if

the stricture be allowed to progress, the compensation of the colon taxed to its utmost, fails distension progresses, and the obstruction terminates acutely or subacutely (p 736) The colon filled with the contents of the small bowel and its own secretion and gases, is distended so greatly that its circulation is impeded, and infection of its walls results. Local infective necrosis of its wall may occur and acute perforative peritonitis follow The perforation will usually be low in the pelvic colon, where distension is greatest and bacterial life most rampant, but it may be, as in any case of colonic obstruction, in the cæcum

The **diagnosis** is readily made by digital and, if necessary by careful sigmoidoscopic examination. Occasionally difficulty may arise in differentiating the simple from the malignant stricture. In simple fibrous contraction there cannot be doubt, but where there is narrowing of the bowel associated with irregular polypoid masses projecting into its lumen the similarity to cancer is sometimes very great. In the simple disease there may be a long history of ulceration of the bowel The polypoid masses have not the characteristically hard and irregular surface of a carcinoma. If doubt exists, a portion of the edge of the thickening should be submitted to microscopy

The **treatment** varies with the site and extent of the stricture, and with the presence or absence of ulceration.

Dilatation.—Strictures situated in the anal canal, e.g the con genital form and those following operations upon the anal canal may be treated satisfactorily by dilatation with Hegar's dilators. Before dilatation, if the stricture is very firm, it may be advisable to incise it at four points situated at the extremities of two diameters at right angles to one another Dilatation will have to be maintained for some time, perhaps during the rest of life. Simple strictures of the lower rectum, say the last inch, may in the absence of ulceration, be treated in the same manner Dilatation of a stricture higher in the rectum is often a difficult matter It may be very dangerous to attempt to force a metal dilator through a stricture. Rupture of the bowel wall may occur with perirectal suppuration or even fatal peritonitis. Soft flexible bougies should be used, if necessary with the aid of the sigmoidoscope Dilatation should be very gradual, and not too much should be done at one sitting A bougie may be left in for some hours if thought advisable, and the patient kept under a sedative After dilatation the ulceration must be treated.

Complete proctotomy.—This may be performed when dilatation is unsuccessful and ulceration extensive The bowel and tissues posteriorly are divided completely from a level above the stricture in the median line, the knife emerging at the tip of the coccyx. Good drainage is secured threatened obstruction overcome and ulceration

given a chance to heal. The after treatment of this septic wound requires unremitting care, and during the healing contraction will occur and constant dilatation will be required. Probably several weeks or even months will elapse before healing is complete. Incontinence of fæces is present at first, but is generally recovered from when healing is complete.

Excision—In strictures of the anal canal which do not respond to dilatation, a modified Whitehead's operation may be performed. This may be a simple operation in some forms of congenital stricture but in postoperative strictures the scar tissue may be dense, adherent to deeper parts, and difficult to dissect. The method has given good results in some strictures which cannot be readily dilated.

In higher lying strictures the bowel may be excised. The principles involved are similar to those of excision of an ulcerated rectum (p 716). The operation is severe and difficult, and must never be lightly undertaken. The contra indications are those given in excision for ulceration (p 716).

Colostomy may be necessary to relieve urgent obstruction. It is indicated in the majority of cases which are complicated with perirectal suppuration, sinuses, and fistulæ. Patients enfeebled by prolonged ulceration are often best treated by colostomy for they are in no condition to stand the severe operation of excision, or the prolonged suppuration after complete proctotomy. By care after the operation the ulceration may heal. It may then be feasible to dilate the stricture or possibly to excise it. Later the colostomy may perhaps be closed (p 717).

PROLAPSE

Prolapse may be defined as a protrusion through the anal orifice of parts normally situated within. It may be *partial* (Fig. 502) when rectal mucosa alone protrudes, or *complete* (Fig 503) when all the coats of the bowel project.

Etiology—The condition may occur at any age, but is peculiarly frequent at the extremes of life, babies and young children furnishing a large proportion of cases.

Normally during defæcation a narrow ring of mucosa protrudes from the anus, and recedes immediately after the completion of the act if recession does not immediately occur prolapse may be said to be present. Any inflammatory swelling of this ring of mucosa with submucous œdema, as occurs in proctitis, may separate the mucous from the muscular wall of the bowel, and predispose to prolapse. Such swelling, in babies and young children may be due to the irritation of worms but probably this cause has been much exaggerated. In diarrhœa the mucosa may be swollen straining

is severe and prolonged and a child suffering from this affection is often allowed to remain seated on the chamber for an indefinite period, thus favouring prolapse. The straining due to phimosis or to vesical calculus is often held responsible but careful inquiry shows that this alone plays very little if any part in the etiology. In adults similar causes may be prevalent, but much more commonly the predisposing cause is a hæmorrhoidal swelling of the mucosa (p. 687). In elderly subjects hæmorrhoids may be present but at this age the straining and local venous engorgement due to urinary trouble, such as urethral obstruction from enlargement of the prostate are often responsible. Operations which have impaired the tone of the sphincters may be followed by prolapse.

Once partial prolapse is established it tends to be progressive

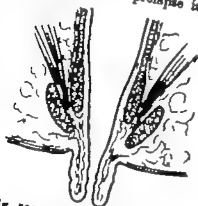


Fig. 502.—Partial prolapse, only the mucosa involved.

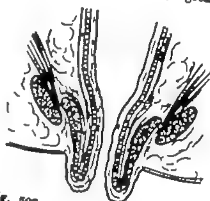


Fig. 503.—Complete prolapse the whole thickness of the bowel wall protruded.

unless promptly and efficiently treated. The sphincters become stretched and partly lose tone thus favouring the increase of the protrusion.

Complete prolapse usually results from a neglected partial prolapse and generally evolves gradually but occasionally the prolapse may be complete and well developed from the beginning.

The conditions essential for complete prolapse are—(1) stretching and eventually relaxation of the supporting tissues of the rectum—the pelvic fascia and the fat of the ischio-rectal fossæ (2) a long mesentery to the pelvic colon (3) relaxation of the sphincter muscles.

Complete prolapse is practically never found in a healthy fat baby but only in the wasted baby with loss of perirectal fat. It is especially seen in association with severe diarrhœa or with some specific fevers, e g measles and whooping-cough the severe cough in these diseases excites the formation of the prolapse The relatively straighter course

of the child's pelvis predisposes to the condition, especially if defæcation is permitted in the sitting posture, in which the rectum is practically a straight tube.

In adults complete prolapse is more common in women who have borne children due no doubt, to a laceration of some of the supporting tissues of the rectum during labour

In elderly subjects a partial protrusion is liable to become complete, for at this age the absorption of fatty tissues supporting the rectum is probable and the sphincters easily lose tone.

At any age a polypus may cause prolapse, partial or complete Such a protrusion is more in the nature of an intussusception than a true prolapse, the part bearing the tumour becoming invaginated into the lower rectum. Intussusceptions of the rectum probably do not occur in the absence of a tumour

Clinical manifestations.—The prolapse at first only occurs at defæcation, and is easily reducible. Later more difficulty is experienced in its reduction. The sphincters in time become stretched and the bowel protrudes on the slightest provocation. The appearances are quite distinctive Projecting from the anus is a more or less cylindrical mass covered with mucosa, and varying from a mere ring of mucosa in the partial, to a thick cylinder of bowel, 5 or 6 in. long, in the complete variety In the smaller protrusions the cylinder is more or less straight, but in the larger it is slightly curved. The mucosa may have a normal appearance if not subjected to irritation and if it be only loosely grasped by the sphincter but when irritated or tightly gripped, it becomes of a dark red or even purple colour In cases which have been allowed to protrude for some time abrasions of the mucosa may occur and in some cases ulceration or acute infective gangrene may supervene In others considerable thickening of the prolapsed part from inflammatory infiltration into the mucous and submucous tissues will ensue The mucosa in the larger protrusions is seen to be arranged in parallel and concentric folds, and the orifice is not infrequently more or less occluded by one of these folds.

In complete prolapse the peritoneum covering the anterior surface of the rectum will be drawn down, and in prolapse of very moderate degree will pass through the anal orifice with the bowel, particularly so in the female, in whom the peritoneum extends lower than in the male. In a large prolapse the peritoneum may completely surround the tube. A hernial sac is thus constituted which may or may not contain an abdominal viscus. *Moschowitz thinks that a prolapse may* be caused by a hernial protrusion of intestine into the peritoneal pouch in front of the rectum forcing its way through the anterior rectal wall The hernial contents have been known to protrude at the anal orifice in front of the prolapsed bowel which is displaced posteriorly

and its orifice directed backwards. The content is naturally in the great majority of cases, small intestine, but the ovaries and bladder have been found. Occasionally adhesions may form rendering the contents irreducible. Strangulation has been known to take place. Attempts at reduction in such cases have sometimes resulted in rupture of the rectum and protrusion of the herniated gut through the rent.

Diagnosis.—The only protrusions from the anus which may be mistaken for prolapse are the simple polypus (very rarely a malignant neoplasm) hæmorrhoids, and an intussusception. A polypus is easily recognized by its pedicle, alongside which the finger can be passed into the bowel. Hæmorrhoids form a series of tumours surrounding the anal orifice. An intussusception may at times cause a little difficulty. In a pure prolapse the mucosa is continuous with the skin at the anal margin whereas in an intussusception there is a distinct sulcus into which the finger may be passed freely all around.

Treatment.—Any prolapse should be immediately replaced. In order to do this the child should be laid across the knee, or the adult upon the left side, and the prolapse well oiled and firmly grasped with the hand. An anæsthetic, in order gently to stretch the sphincters, may be necessary. Gentle pressure in the majority of cases will succeed in reduction. The part protruded last is the apex and this must be returned first. If reduction be not done immediately inflammatory changes and those resulting from the grip of the sphincters may produce serious consequences, and render replacement very difficult or impossible.

Recurrence must be prevented by removal of the cause. Thus, in children diarrhœa and the feeble wasted condition must receive treatment and, above all the child must not pass the motions in the sitting posture, but must assume the squatting position on a low pan or better a recumbent attitude in this position the lower sacrum and coccyx are bent and the rectum is more supported than in the sitting posture. In children this line of treatment will usually cure the disease but in a very small minority in spite of all care, the prolapse will recur demanding some form of operative treatment. In adults similar lines of treatment should be instituted in the first place, but in the majority of these no cure will result, and operative treatment is indicated.

Numerous pessaries have been invented to prevent prolapse, but all are unsatisfactory and should only be employed when there are special contra-indications to operation.

Many and varied operative procedures have been performed for prolapse of the rectum, among which the following may be mentioned —

1 **Searing the mucous membrane with the actual cautery** —This is applicable where the prolapse is only partial. It is especially

useful in children, and for slight cases in adults where there is no hæmorrhoidal condition of the mucosa The object of the cautery is to cause limited sloughing of the mucosa and thus narrowing of its circumference, and also to promote adhesions of the mucosa to the muscular coat With the bowel protruding, the point of the Paquelin cautery at a dull red heat is drawn from its base to its apex, in a series of longitudinal lines. Care must be taken to prevent the action of the cautery extending too deeply as serious perirectal inflammation might occur A second application may be necessary

2. **Excision of the mucous membrane.**—In prolapse of slight degree, and particularly in children in whom the cautery has failed to effect a cure, V-shaped portions of the mucous membrane may be excised. It will generally suffice to remove two such pieces, one anteriorly and the other posteriorly The mucosa is clamped, incised, and the submucous tissue ligatured as in the operation for hæmorrhoids, or the mucosa is completely excised and its edges are sutured. The extent of removal depends upon the proportions of the prolapse.

3. The whole circumference of the mucous membrane may be excised and the cut edges of the mucosa united to those of the skin—**Whitehead's operation** This procedure is suitable for prolapse caused by a *hæmorrhoidal condition of the mucosa of the rectum, for any partial* prolapse, and for some cases of complete prolapse of very moderate degree. In the latter class, when the mucosa has been united to the skin the muscular wall of the bowel will be folded, and adhesions of the mucosa to the pleated muscular wall will prevent a further tendency to prolapse. The objection to this operation is the possible loss of anal sense and incontinence which may result (see p 693)

4 **Rectopexy**.—The object of this operation is to fix the rectum by some means or other to the sacrum and lateral pelvic walls. Sutures have been employed to secure this fixation, but a better method is probably that described by Lockhart Mummery A transverse incision is made between the coccyx and anus, deepened to the apex of the coccyx, the external sphincter is severed from the bone, and the space between the rectum and sacrum freely opened by finger dissection. The separation of the tissues is continued laterally around the rectum, with all care to avoid hæmorrhage and injury to nerves. On no account must the rectum be injured or the wound be contaminated from the anus during the operation such contamination would cause acute infection and destroy all chance of success. The depth to which the separation is carried out bears a direct relation to the length of the prolapse. The cavity thus made is plugged firmly not tightly with sterilized gauze If the plugging is too tight, the blood supply of the rectum will be endangered. The anus is lightly plugged to prevent contamination. The bowels are not allowed to act for several

days, until it may be assumed that granulations cover the wall of the cavity and infection will not occur The packing is left in for several days, and then slowly removed daily fresh packing being inserted so that the wound may close from the depths, which it does in about three weeks. When it has healed, the rectum is firmly adherent posteriorly and laterally

This operation is suited for cases of complete prolapse of moderate degree and has given very good results in the hands of its author Its limitations cannot be clearly defined.

5 **Excision of the prolapsed portion.**—This method and the next are reserved for cases of complete prolapse in which on account of their length, rectopexy can hardly be expected to succeed. The protrusion is covered with sterile gauze and drawn well down and an incision is made about ¾ in. from the anal margin, and parallel to it, into the prolapse. This will in all probability be below the level of the internal sphincter muscle The incision is deepened through all the layers of the gut and the peritoneal cavity opened. When this is done, care must be taken to avoid injury to any herniated intestine which, if present, should be returned into the pelvic cavity The peritoneal cavity is closed by sutures at once. The incision should then be carried through the whole circumference of the protruded gut. All hæmorrhage must be arrested. The edges of the proximal portion of the gut are now sutured to those of the distal portion surrounding the anal margin. This operation is difficult, and by no means free from the risk of fatal peritonitis. Recurrence may take place and the patient should be kept under observation for some time, for fear of contraction necessitating dilatation.

6 **Fixation of the gut within the abdomen**—This procedure is an alternative to the foregoing, and opinion is by no means unanimous as to which operation gives the better results Its object is to anchor the pelvic colon within the abdomen and so long as the anchorage remains prolapse cannot recur but unfortunately adhesions are liable to stretch and some recurrence to take place.

There are two places at which the colon may be fixed—(*a*) the peritoneum of the anterior abdominal wall and underlying transversalis fascia and (*b*) the iliac fascia and peritoneum of the iliac fossa. In either case after the abdomen is opened the colon is drawn upwards as far as possible and fixed in this taut position by sutures. In the former case the peritoneum is raised from the anterior abdominal wall on either side of the incision, its two edges are sutured to the walls of the colon and the longitudinal band upon the latter is sewn directly to the transversalis fascia. Thus a broad surface for adhesion is secured. In the latter case the principle is similar the peritoneum having been lifted from the iliac fossa, the bowel is sewn to the iliac

fascia, and the peritoneum to the walls of the bowel. In all probability this gives a firmer anchorage than the former method, and it is certainly less likely to cause, at a later date intestinal obstruction (from bowel kinking or twisting of a coil of small intestine around the stretched band of adhesion) or pain from the dragging of the adhesions, both of which have been known to follow the anterior fixation.

INCONTINENCE

The external sphincter is the muscle whose action gives complete continence, and anything which interferes with its action may cause some degree of incontinence The anal canal is endowed with a special sense the anal sense, which detects the presence of anything in the anal canal and differentiates between liquid and gas. If this mucosa is destroyed, a form of incontinence may result.

Etiology—Only local causes of incontinence are treated here. Broadly speaking, they may be divided into two classes (1) loss of anal sense, and (2) any cause interfering with the action of the external sphincter muscle.

(1) *Loss of anal sense*—This may occur after excision of the whole of the anal mucosa it would appear that if a portion only of the mucosa be left, anal sense is not impaired. This condition may occur after the Whitehead operation for piles, and, as already mentioned (p 693), is a serious argument against its performance If loss of anal sense is the sole cause of incontinence probably nothing can be done to cure the patient.

(2) *Interference with the action of the external sphincter*—A protruded hæmorrhoid or a prolapse may prevent complete closure of the sphincter muscle and a mild degree of incontinence may result. This condition is generally detected and easily remedied. The external sphincter muscle may be damaged during childbirth and has been known to be injured by direct wounds. Following its division for a fistula, especially when it has been divided at the lateral margins of the anus and somewhat obliquely healing of the muscle may be faulty a distinct gap or stretched scar may result. Scar tissue at the anal margin e g following Whitehead's operation, may hamper the action of the sphincter In the healing of a fistula, or following a faulty operation for the ligature of hæmorrhoids, a marked puckering of the anal margin may occur which renders perfect closure of the anus almost impossible The same may occur after the removal of anal growths.

The **treatment** is some form of plastic operation. When the trouble is caused by a wound which has resulted in imperfect healing of a divided sphincter an attempt must be made, by raising a flap to expose the sphincter muscle, define the ends, freshen them and unite

them by suture. If the ends of the muscle cannot be exposed sutures may be inserted to close the gap at the anal margin thus narrowing the anus, so that the sphincter can work more efficiently If scar tissue following a Whitehead's operation, or any other operation in the anal canal is the cause of the incontinence it must be excised and the muscle freed and primary union of the wound secured. The scar tissue resulting from the healing of a fistula should be excised, and if the sphincter is also injured it should be treated as above.

These operations may be very difficult, and minute attention must be paid to surgical cleanliness and detail. All buried sutures must be absorbable. Primary union of the wound must be secured and unremitting care of the wound during its healing is of paramount importance.

BENIGN TUMOURS

Adenoma of the Rectum

Adenoma of the rectum is common in childhood, but less frequent in later life. It originates in the mucosa, at first is sessile but usually becomes pedunculated it forms a firm, bright red swelling with a smooth or lobulated surface. It is composed of glandular tissue similar to the glands of Lieberkühn occasionally it may undergo cystic degeneration. In children it is invariably pedunculated and rarely exceeds the size of a cherry whereas in adults it is relatively more frequently sessile and may attain much larger dimensions (Fig 504) It is usually single in the child, but in the adult it is relatively more commonly multiple (Fig 505) In children the adenoma invariably remains a simple tumour but in later life it by no means infrequently becomes malignant. Many instances are recorded in which the removal of an adenoma by cutting through the base of attachment has been followed by a malignant growth. Simple adenoma and carcinoma may be present simultaneously The irritation of the discharges in some cases of proctitis, ulceration or cancer may cause adenomatous formations.

The **symptom** is painless hæmorrhage sometimes this is accompanied by mucoid discharge. If the adenoma originate low in the rectum or if the pedicle be sufficiently long, the polyp may protrude through the anus. Rarely will the pedicle become gripped by the sphincters, and the tumour slough off. An adenoma is seldom (probably never in the child) of sufficient size to cause impediment to the passage of fæces. A simple neoplasm may be the starting point of an intussusception of the rectum.

Diagnosis.—When the tumour is pedunculated the diagnosis is easy as by digital examination the pedicle can usually be felt if the tumour be high-lying a sigmoidoscopic examination will always reveal

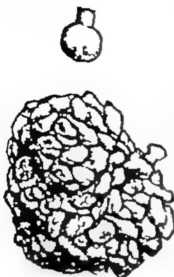


Fig 504. — Adenomatous polypi from a child and an adult.

the true condition. The diagnosis of a sessile adenoma can often only be made by microscopy

Treatment.—An adenoma should always be removed. In the child it is sufficient to cut it off after ligaturing, cauterizing clamping, or twisting the pedicle In the adult similar treatment will suffice for an obviously pedunculated and undoubtedly innocent tumour If there exist any suspicion of malignant disease, the base of attachment and the adjacent mucosa should be removed and submitted to microscopy and if malignant transformation be found, the case must be treated accordingly

PAPILLOMA OF THE RECTUM

The so-called villous tumour of the rectum is rare it resembles the villous tumour of the bladder and the pelvis of the kidney and consists of a lobulated spongy mass, sessile or pedunculated, with long villous tufts studding its surface these tufts are composed of mucous membrane and are very vascular (Fig 507) The villous tumour is confined to adult life and is very liable to become malignant it may be single or multiple if pedunculated it always has a short and broad pedicle. The **symptoms** are hæmorrhage and a glairy white discharge which seems characteristic. Occasionally the tumour may protrude through the anus, or portions may become detached and then be passed in the

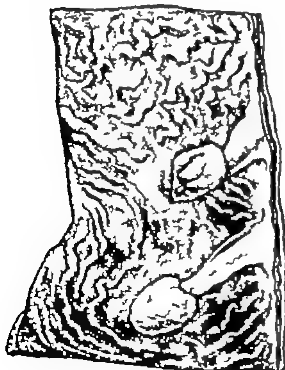


Fig. 505.—Two pedunculated adenomas.

motions. The **treatment** is always removal. The tumour, the pedicle if present, and the adjacent mucosa should be excised, the edges of the mucosa being sutured. *Microscopical* examination is essential, and if malignant transformation has taken place the case must be treated accordingly.



Fig. 506.—Section of rectal adenoma.

PAPILLOMA OF THE ANUS

Papillomatous masses occasionally arise in the anal canal, or in the skin immediately surrounding the anus. They are typical papillomas, covered with squamous epithelium. They resemble the venereal warts of the genitals, and are probably always caused by the irritation of discharges, either from the genitals or from the rectum. These warts must be treated by attention to their causes, strict cleanliness, and the application of a dry powder. If no improvement follows, they may be removed by the knife or by the application of carbonic dioxide snow

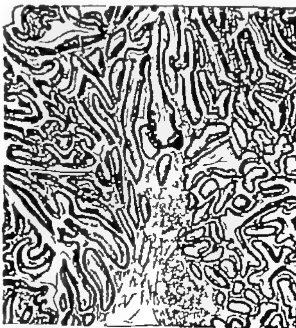


Fig. 507.—Section of rectal papilloma.

Fibroma

Swellings consisting of fibrous tissue are sometimes seen in the rectum and anal canal, but the majority of these are not tumours in the true sense of the word they are inflammatory in origin. Occasionally a true fibroma occurs it may be single or multiple, sessile or pedunculated, and is usually *of small size, although a few instances* are recorded in which the tumour reached large proportions. Mixed fibromas, such as fibro-myoma and fibro-myxoma have been recorded but are very rare The symptoms are similar to those of adenoma.

Lipoma of the Rectum

Rectal lipoma is rare in many of the cases recorded as such the tumours really originated in the pelvic colon either as submucous or as subserous growths when the latter the pedicle contains a protrusion of peritoneum—*a point to bear in mind* when operating upon these tumours through the rectum. The symptoms are very indefinite. If large, lipomas may cause obstruction they have been known to become extruded and cast off.

Vascular nævi lymphomas and tumours consisting in part of *bone* and *cartilage* have been described as occurring in the rectum, but they are all exceedingly rare.

MALIGNANT TUMOURS

Sarcoma of the Rectum

Rare anywhere in the intestinal tract, sarcoma attacks the rectum slightly more frequently than the bowel above. It affects the two sexes equally it has usually been recorded in middle-aged or elderly subjects.

All types of sarcoma have been recorded—round-celled, spindle-celled, alveolar lympho- and melanotic. The spindle-celled appears to be the most frequent variety The growth usually originates in the submucosa, but is said to commence sometimes in the muscular wall. It forms a sessile mass projecting into the lumen of the bowel occasionally it may become more or less pedunculated, and has been known to prolapse during defæcation. It may involve only a limited portion of the rectum, but occasionally tends to grow extensively both circumferentially and vertically clinically resembling chronic *inflammatory conditions* for which it has not infrequently been mistaken. The mucosa covering a sarcoma may sooner or later ulcerate. The growth tends to invade parts surrounding the bowel.

The melanotic variety has usually occurred at the anus, but has been seen also in the rectum. It is very malignant, visceral deposits occurring early

The **symptoms** are somewhat similar to those of carcinoma (p. 735) The lumen of the bowel is, however less encroached upon and the obstruction less pronounced *ulceration* is late, and hæmorrhage less marked.

Diagnosis.—A sarcoma has to be differentiated from carcinoma from chronic inflammatory affections, and from the diffuse ano-rectal syphiloma. In the early stages its submucous position will distinguish it from carcinoma, but later when ulceration is present clinical diagnosis may be impossible. Similarly differentiation between an ulcerating sarcoma and chronic inflammatory ulceration may be clinically impossible and even extremely difficult microscopically

The **operative treatment** is similar to that of carcinoma (p. 737) The ultimate prognosis is bad, recurrence nearly always taking place shortly after removal. Radium may be used beneficially



Fig 508.—Cancer of rectum.

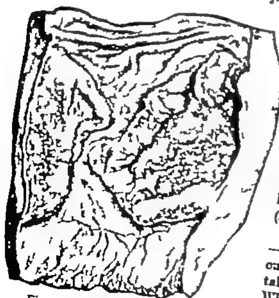
CARCINOMA OF THE RECTUM

A carcinoma may originate in the rectum the anal canal, or the skin at the verge of the anus. About 3 per cent. of primary cancers occur in the rectum. *Cancer is four or five times as frequent in the rectum as elsewhere in the intestine.* Cancer of the anal canal is much less common.


Fig 509.—Cancer of rectum.

Carcinoma of the rectum occurs most frequently between 40 and 60 years of age, but is by no means uncommon under the age of 40. Youth is not exempt the writer has seen it at ages of 13, 14 and 15 The younger the patient, the more rapid and malignant the growth.

The growth is nearly always single A few cases are recorded in which two apparently primary growths were present in the rectum, and rarely two primary growths have been reported, of which one was in the rectum and one elsewhere. The tumour may originate in any part, but a common starting point is low down within reach of the finger another favourite site is at the junction with the pelvic colon. Figs. 508 509 510 511 illustrate different appearances of cancer in different parts of the rectum.


Fig 510.—Cancer of rectum.

Pathology —The growth is columnar-celled (Fig 512) and originates in the glands of the mucosa. It spreads by (1) direct extension through continuity of tissue, (2) the lymphatic channels, and (3) the blood-stream.

1 **Direct extension.**—The vertical and circumferential extent of rectal cancer varies greatly When first seen, it may be a small nodule involving a very limited surface

of the bowel wall in occasional cases it may have almost surrounded the entire bowel Between these two all possible varieties exist.

The growth, originating in the mucosa, invades the muscular coats (Fig 513) and sooner or later the perirectal tissues. Thus the tissues of the ischiorectal fossæ may be invaded, the presacral and precoccygeal tissues may be infiltrated, and the growth may become fixed to the pelvic walls and invade nerve-trunks the bladder prostate and seminal vesicles, or uterus and vagina, according to sex may be infected, and in high lying growths the peritoneum may be involved. Rarely the growth extends down the anal canal, and may protrude at the anus.

2. Lymphatic spread —In the rectal wall there is a lymphatic plexus in the submucous tissue and one between the muscular coats of the bowel, communicating freely with each other Many investigators by numerous microscopical examinations have shown that there is little tendency for the cancer to permeate in the bowel wall along these plexuses to any extent beyond the naked-eye limits of the growth. Hence removal of an extensive length of bowel is not necessary on account of infiltration of the bowel wall plexuses Rarely an investigator has found cancer cells in these plexuses at a distance of some inches from the naked-eye edge of the growth. Such cases are in all probability highly malignant, and they cannot be recognized clinically Fortunately this lymphatic permeation seems to be very rare.



Fig. 511 —Cancer of rectum.

Vessels pass from the intramural plexuses through the pararectal glands which lie in close connexion with the lateral and posterior surfaces of the rectum along its whole length. Efferent vessels from these glands run in more or less close association with the hæmorrhoidal veins. From the anal canal the vessels pass across the ischio-rectal fossa, and thence with the internal pudic vessels to the glands in relationship to the internal iliac vein. From the lower rectum some efferent vessels pass through the bowel wall to a plexus between the levator ani and the pelvic fascia, which drains into the internal iliac glands; above this the vessels accompany the superior hæmorrhoidal veins, passing underneath the peritoneum on either side of the bowel at the floor of the pelvis, thence between the layers of the pelvic mesocolon near its attachment to the pelvic wall, to a chain of glands along the main hæmorrhoidal vein to its termination at the site of bifurcation of the iliac arteries, communicating in the mesocolon with the paracolic glands, and sending efferent vessels to the lumbar glands. Experimental injection of the lymphatics of the rectum shows that in some cases those from the lower portion of the bowel may pass to the oblique inguinal glands. This, however, is not confirmed by clinical experience, since these glands are not invaded by a rectal cancer.

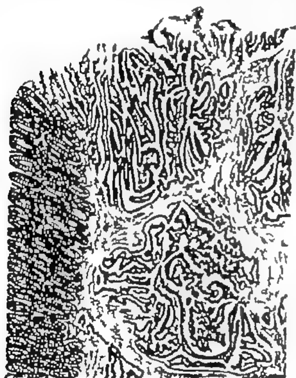


Fig. 512.—Edge of a malignant ulcer of rectum, showing typical appearance of columnar-celled cancer.

It is quite impossible to state at what time in the history of a rectal cancer glands in the immediate neighbourhood or those more remotely placed, are diseased. As a rule, it is generally admitted the longer the duration of a growth the more extensive will be the glandular involvement. Clinically, as applied to the operative treat

ment of rectal cancer this rule is of little value. The malignancy of cancer and its method of spread vary very greatly In some cases the natural tissue-resistance of the patient is very great, the rate of growth very slow and the glands may be free from disease for a very long time, or if they are diseased, involvement may be comparatively little and the original slow growth is reproduced in the glands. On the other hand, in a comparatively small primary growth glandular invasion may be early and extensive. The duration of disease and the extent of primary growth form no criterion of the extent of glandular involvement.

Enlarged glands in cancer of the bowel are not necessarily cancerous. There is frequently associated septic infection, which is sometimes the sole cause of enlargement of some glands.



Fig 813.—Section of rectal cancer showing infiltration of the muscular wall.

3 **Spread by the blood stream.**—We are entirely ignorant of the processes which govern the spread of cancer by this route. Visceral metastases are not necessarily a late occurrence. We have insufficient data to judge of their frequency but in all probability this method of spread is comparatively infrequent. In 50 consecutive autopsies upon persons dying from the disease, at very varying intervals after the appearance of symptoms, the writer found metastases were recorded in 7 only in all the liver was involved, and in 1 the spleen in 3 secondary growths were scattered over the peritoneum, but possibly in these the spread was by the lymphatics. Metastatic deposits in bone have been recorded.

Symptoms.—The typical early symptoms are those of ulceration and later those of stricture are superadded (see pp 714 and 718) A little hæmorrhage, and perhaps mucus, with the motion, repeated calls to go to stool, especially in the early morning, with the discharge of a little flatus, slime, and blood, and a feeling of unsatisfactory bowel

action, are usually the earliest symptoms. The patient considers he is suffering from piles, and as the symptoms do not at first prevent the daily occupation and enjoyment of life they are neglected. In intensity each symptom varies within wide limits. Hæmorrhage and the teasing diarrhœa may be absent for some time clinical evidence of material narrowing of the lumen of the bowel may be long delayed, and indeed in a few cases the disease may run its course without symptoms of obstruction appearing in others again, symptoms of obstruction may be the initial manifestation, and in such the disease has advanced insidiously without symptoms of rectal ulceration of sufficient intensity to arrest the patient's attention.

If untreated, rectal carcinoma leads to a fatal issue in about one and a half to two years after the onset of symptoms, on the average in some cases life is terminated much earlier and in others is much longer prolonged. Not infrequently the end comes from acute intestinal obstruction, arising in various ways. Most commonly the bowel above the constriction becomes exhausted, and the colon progressively dilates. Occasionally the distended pelvic colon may undergo torsion around its mesenteric axis. In any obstruction of the large bowel the cæcum may be the most distended part, and occasionally an acute dilatation of the cæcum may be the initial evidence of failing compensation. Should such a cæcum have retained its original peritoneal relationships, and be suspended by a mesentery a volvulus around its mesenteric axis may occur Rarely the diseased part becomes invaginated into the lower bowel. Very infrequently the small lumen left by the invading growth may be occluded by a fæcal mass or a foreign body such as cherry or plum stones.

In a few cases peritonitis may cause death. Bowel distended by mechanical obstruction is predisposed, partly by virtue of its impeded circulation, to infection. In cancer of the rectum the pelvic colon or cæcum may thus become acutely infected, and necrosis of the walls may result, with local or diffused peritonitis, which is practically always fatal

In the absence of these complications, factors which aid in the fatal termination are exhaustion from repeated hæmorrhages, pain especially when the large nerve-trunks are involved sleeplessness from the incessant diarrhœa and pain, and absorption of toxins.

Diagnosis.—It should be a cardinal rule thoroughly to examine every case presenting the slightest symptom of rectal trouble If this rule were followed, and patients encouraged to present themselves on the first evidence of rectal disease, cancer would generally be recognized without difficulty at an early stage. Symptoms have generally been present for weeks or months before patients present themselves

for examination. The irregularly hard growth projecting into the lumen of the bowel with thickened edges, and irregular surface, depressed in places and raised by cauliflower-like masses in others, is quite characteristic. Investigation under anaesthesia and with the sigmoidoscope is necessary to detect a growth beyond the reach of the finger and should never be omitted.

Although in most cases the cancer is typical to sight and touch, it may sometimes be confused with other diseases. Chronic septic and tuberculous ulcerations, especially when associated with polypoidal masses of swollen and œdematous mucosa, are apt to be mistaken for carcinoma. The history, the flat and comparatively superficial ulcer and the absence of induration will generally serve to differentiate these conditions. If any doubt remains, a portion of the advancing edge of the ulcer or growth must be submitted to microscopy without delay. At times diagnosis between a benign and a malignant neoplasm of the rectum may be difficult (p. 728). The rare sarcoma may usually be distinguished by noting that it is a submucous rather than a surface growth.

Treatment of removable cancer.—Aside from the still very problematic benefits that may accrue from radium treatment the only chance of cure is offered by operation. Unfortunately so many patients present themselves for examination so late that the disease has progressed beyond the limits of surgical removal, and only the palliative operation of colostomy can be done. The percentage of cases, operable when first seen, is very variously given by different authors; probably in only some 50 or 60 per cent. can the surgeon justifiably recommend radical removal.

Tests of operability.—A cancer of the rectum may be considered to be "removable" when the growth is confined to the rectal walls when glandular invasion, as seen by abdominal exploration, can be excised, and when visceral deposits are absent. In order to determine the limits of a rectal growth and its operability it is often necessary to examine under anaesthesia, when what was thought to be a fixed growth previously may be found to be movable upon surrounding structures. Exceptions to this rule are numerous. For instance slight invasion of the prostate has been successfully dealt with by ablation of a portion of the gland; similarly the posterior vaginal wall and indeed the uterus in a few chosen cases, have been successfully removed; so has an adherent loop of small intestine. Invasion of the perirectal cellular tissue does not necessarily contra-indicate removal, but fixation to the pelvic wall does.

Infection of the peritoneum of the pelvic floor either by the growth or by lymphatic permeation precludes removal. Each case must be judged on its own merits, due regard being paid to the age and general

condition of the patient. Any operation for the removal of a cancerous rectum is a very formidable undertaking and attended with serious risk; therefore the general health and the functions of the vital organs must be thoroughly tested beforehand.

It must be clearly borne in mind that in the phases of acute or subacute obstruction no removal operation must be considered until that obstruction has been suitably treated.

Operations available.—There is still lack of unanimity among surgeons as to the type of operation to be recommended. It is universally agreed that in operations for cancer a cardinal principle is to remove the primary growth and its area of lymph drainage widely and in one intact mass, division across the track of lymph drain being acknowledged to be likely to encourage recurrence. The application of this rule to rectal cancer implies the removal of the cancerous bowel with a sufficient length of gut above and below and of all its lymphatic field that can be taken with reasonable safety. It is not necessary for the cancer *per se* to remove much gut above and below the growth for as already stated, the intramural lymphatics are rarely invaded far beyond the edges of the growth as seen by the naked eye. Excision of this lymphatic field, however entails removal of the sphincteric region through which lymphatics pass, the contents of the ischio-rectal fossæ, the levatores ani and the adjacent pelvic fascia, the perirectal tissues in front of coccyx and sacrum, the peritoneum of the pelvic floor adjacent to the bowel the whole of the pelvic mesocolon, and, inasmuch as this destroys the blood supply to the bowel, the pelvic colon rectum and anal canal. A permanent colostomy is required.

The operation devised for the purpose is known as the *combined abdomino-perineal operation* The patient is put in the Trendelenburg position, and the abdomen opened through a left paramedian incision The removability of the growth is confirmed by noting the absence of visceral metastases, a free peritoneum of the pelvic floor and absence of lumbar glands. The pelvic colon at its extreme upper end, is divided between clamps with the cautery or doubly ligatured after being crushed with a broad powerful clamp leaving a proximal portion just sufficient to reach the surface in the iliac region for the purpose of forming a permanent colostomy there Each end is immediately closed with a running suture to prevent leakage.

The superior hæmorrhoidal vessels are isolated and ligated in such a position as to ensure a vascular supply to the proximal loop of colon that is to go to the colostomy opening The peritoneum on each side is divided vertically at a distance of about one inch from the sides of the bowel, and the incision carried transversely across between the bowel behind and the bladder or the vagina in front. The colon and

mesocolon are freed from the sacrum and coccyx, and the rectum is separated from the viscera in front by careful division of the pelvic fascia down to the upper surface of the levatores ani. The colon thus freed, with its mesocolon and all the neighbouring areolar tissue from the hollow of the sacrum, is pushed to the bottom of the pelvis and the peritoneum lining the pelvic walls is raised and sutured completely over the detached mass, so that the latter is now excluded from the peritoneal cavity. To ensure complete repair of the peritoneum of the pelvic floor it may be necessary to borrow some peritoneum from the broad ligament or the bladder.

The closed lower end of the proximal colon is brought out through a separate small wound through the left rectus muscle or through the iliac region and fixed there. A soft rubber catheter is inserted through a small hole in the colon through which continuous saline solution may be given during the remainder of the operation if thought necessary. This allows the escape of flatus and infusion of saline during the following forty-eight hours, when the aperture is enlarged and becomes a permanent colostomy. The abdominal wound is then sutured.

The patient is placed in the lithotomy or the left lateral position, the anus is closed by purse-string suture after an iodized gauze swab has been inserted into the rectum from below. A mesial incision is then made from the lower part of the sacrum, over the coccyx and forward to encircle the anal region. The coccyx is removed, and the fascia between it and the bowel incised. The isolated pelvic colon is delivered through the perineal wound, and the levatores ani are divided as near their origins as possible, and the rectum carefully freed from its anterior relations. The whole mass, containing pelvic colon, mesocolon, rectum, perirectal tissues and levatores ani, is thus removed in one piece. The cavity left is allowed to close by granulation.

Two surgeons can, if available, work together one from the abdominal and the other from the perineal aspect. The patient is placed in the lithotomy position, but with legs and thighs extended at an angle of 45° from the trunk instead of flexed up as in the ordinary lithotomy position. This plan not only reduces the time taken, but facilitates the operation, because the two surgeons can help one another with information as to the exact position of viscera, such as bladder, etc.

The arguments in favour of the abdomino-perineal operation are as follows:—

(1) The presence or absence of carcinomatous deposits in the viscera or in the pelvic floor can be ascertained; the presence and operability of glandular involvements can be estimated.

(2) High rectal growths can be removed better than by any attack from below only

(3) It is a sincere attempt to remove, *en masse* with the carcinomatous organ, all its field of lymphatic involvement.

The argument against the operation is based on its mortality which is variously given by surgeons of varied experience as from 15 to 60 per cent. The mortality depends on several factors, and perhaps might be reduced by close attention to their avoidability (*a*) Shock is the most frequent cause of death it may be combated by the previous preparation of the patient, by careful selection of the anæsthetic method suitable for each individual case by manipulative dexterity and rapidity and by the infusion of saline either subcutaneously or into the colon during the operation. (*b*) Accidental infection with fæcal material through careless technique by wounding of the gut may cause acute gangrenous cellulitis or peritonitis and death it should be avoidable. (*c*) Intestinal toxæmia may be a contributory factor it should be prevented by careful preparation of the patient, and by not operating during an obstructive stage. Where any obstruction or accumulation of fæces in the colon is prominent in the case, it is often advisable to do a preliminary cæcostomy or to do the operation in two stages by dividing the colon through a small iliac incision bringing the lower end of the proximal portion, closed, out through the wound to be opened as a colostomy later and dropping the other end also closed, back into the pelvis after some days of drainage of the gut the cæcostomy or the colostomy can be temporarily sealed the abdominal wall thoroughly cleansed, and the operation continued through a mesial incision. (*d*) Healing and convalescence are prolonged and tedious, and there is a danger that the patient may pass into a condition of decubitus, or that his reparative processes may fail especially as he is often a man past middle life Care should be taken to bring to his notice some new daily changes, and to keep alive his hopes and interests he should be moved into a wheeled couch at the earliest date possible (*e*) Retention of urine may follow the operation. It may be partial and overlooked unless examined for When untreated it may contribute to a fatal issue from renal complications or from septic cystitis.

An operation of this magnitude can only be justified if its end results are definitely better than those of other less severe measures. Statistics in this subject are rather vague, but figures published by Ernest Miles tend to show that although the operative mortality may be high, the combined operative and recurrence mortality is less than that of other operations in which recurrence is so common because the lymphatics of the pelvic floor and mesocolon can only be inadequately removed.

If this operation appears to be contra indicated, or the surgeon considers his mortality rate too high, the growth is removed by *perineal excision*, in which the operation is conducted entirely from the perineum and removes as much of the lymphatic drain as is possible from this method of approach. The tissues of the ischio-rectal fossæ the presacral and precoccygeal tissues, the levatores ani and fasciæ, i.e. the tissues supporting the adjacent lymphatic drain with the rectum, are all removed. Formerly the severed end of the rectum or the pelvic colon was often brought to the perineum, and a perineal anus left. This is an ideal method if sphincter control can be preserved. In low lying growths the sphincteric region certainly should be removed. In higher growths it may be thought justifiable to retain the anal canal. Even so, if removal of perirectal tissues is carried out thoroughly the nerve supply to the external sphincter muscle will be severed and, however perfect the anatomical result may be, control will be lost. Preservation of the nerve to the external sphincter muscle can only be obtained by encroaching very sparingly on the tissues of the ischio-rectal fossæ Admittedly perfect control has been secured after the operation. It is gained at the expense of a greater liability to recurrence due to a less thorough removal of the lymphatic drain. It may be that a patient is willing to risk this for the advantage of a normal anus. Often the attempt to preserve a normal anus fails completely because (1) the nerve supply of the external sphincter muscle is destroyed, and (2) the bowel sutured to the skin of the anal margin does not unite by first intention it recedes, and the wound closes by granulation so that a contracted anus results, and the scar adherent to the muscle prevents the latter from effectually closing the anus. If no attempt to preserve the normal anus is intended a permanent inguinal colostomy should always be made, as this is more satisfactory for the patient to attend to than an artificial perineal anus, and is better adapted for the application of a receptacle.

The best perineal operation is performed as follows The inguinal colostomy is done some week or ten days beforehand, the patient is placed on the left side or in the lithotomy position, and the anus is sealed by a purse-string suture a vertical incision is made over the lower sacrum and coccyx encircling the anus. The coccyx is removed, the incision is deepened, severing the levatores ani as near to their origin as possible, and the anal canal and rectum are very carefully separated from the tissues in front, viz. the vagina or the urethra, prostate and bladder. The bowel is separated from the sacrum The whole rectum, thus freed, is drawn down and the peritoneum on its anterior and lateral surfaces exposed. The peritoneal cavity is opened, and the pelvic mesocolon divided by a succession of incisions, the vessels being clamped as they are cut, until the pelvic colon is

mobilized sufficiently to enable clamps to be placed upon it at a selected spot quite free from the growth The bowel is divided between the clamps with the cautery The proximal end of bowel is completely closed by a running suture and dropped into the pelvis, and the peritoneal cavity closed. The skin wound is now closed. During the operation the urethra must be carefully avoided, and it is advisable to pass a sound into it to determine its position. On no account must the rectum be wounded if so, acute infection will occur which may end fatally or at the best *convalescence will be very prolonged.* The *cul-de sac* of colon left causes no trouble provided the colostomy is efficient and no fæces are allowed to pass beyond it. The operation should be an entirely aseptic one and union should be obtained by primary intention. The convalescence, therefore, should be smooth and rapid. In dividing the pelvic mesocolon the incisions must be close to the bowel, so as to ensure the blood supply to the colon, otherwise gangrene of the colon may occur with disastrous results.

The mortality of this operation is *decidedly lower* than that of the abdomino-perineal method, and hence it is the operation of choice with many surgeons.

As it is entirely performed from the perineum, it is impossible to estimate whether any secondary visceral or peritoneal deposits are present only a very limited examination can be made with the finger in the wound at the time of performance of the colostomy It is impossible to foretell the presence of intestinal adhesions to a high-lying rectal growth. The operation can only deal with the lymph drain in the pelvic mesocolon very imperfectly

If it is intended to make an attempt to preserve the normal anus, a preliminary colostomy (which is closed later) should always be done and the bowel distal to the colostomy cleansed as far as is possible If this procedure is not adopted, infection of the wound always occurs, the sutured bowel fails to unite to the skin, and a stricture and imperfect function of the sphincter result. A preliminary colostomy tends to limit the infection, but by no means prevents it. The rectum is isolated as before, except that the anal canal is untouched, and the peritoneal cavity opened. The colon is mobilized sufficiently to enable it to be brought to the anal margin without tension. The rectum is divided just above the anal canal, the mucosa of the canal removed, the colon drawn through the canal and sutured to the skin.

Treatment of irremovable cancer — Discovery of an irremovable rectal cancer does not always demand immediate performance of colostomy A few cases of rectal cancer will run their course without any necessity for the operation. There is little evidence to show that the rate of growth is delayed by diverting the passage of

fæces over it, but symptoms may be very much relieved. The indications for a palliative colostomy are—

Intestinal obstruction, acute or chronic.

Hæmorrhage apparently caused by fæces passing over the growth.

Pain caused by the presence of fæces in the bowel

The teasing diarrhœa.

Hæmorrhage and diarrhœa may be relieved by curettage and cauterization, but the symptoms will almost surely recur when the process may be repeated

Apparent cures have followed treatment by radium in any case it may relieve symptoms such as bleeding, discharge, or pain if used it may be applied per rectum by means of a tube containing 100–200 mg of radium bromide, inserted into the lumen at the region of the growth and left there for 12–24 hours. Needles of emanation can also be used, inserted directly into the growth



Fig 514.—Section of squamous-celled cancer of anal canal.

Carcinoma of the Anal Canal

Anal cancer (Fig 514) originates from the lining of the anal canal or the skin of the anal margin. There is evidence to show that in a few cases it has grown from the edge of a chronic fissure or ulcer

Generally speaking, the squamous-celled tumour is of slower growth than the glandular cancer and usually cancer of the anal canal conforms to this rule. Anal cancer is, however of more rapid growth than many forms of skin cancer The disease spreads (1) by *continuity of tissue* to the skin of the perineum (though it does not tend to infiltrate the rectal wall to any extent) (2) by *the lymphatic system*. The glands invaded are those in the groin—the oblique set of the

inguinal glands. If the growth extends up the anal canal the pelvic lymphatics may be invaded as in rectal cancer

Symptoms.—Since the growth is at the anal margin, pain is present from the outset. At first only experienced when the bowels move, it later becomes more or less constant. Some blood-stained discharge occurs early and this is constant, and independent of the bowel action. Pruritus ani may be severe. Symptoms of intestinal obstruction may or may not be present, depending upon the degree of occlusion of the anal canal. As the growth infiltrates the sphincters, incontinence of fæces results. On examination there will be seen the typical appearance of a squamous-celled carcinoma.

Diagnosis.—The disease has to be differentiated from a chronic indolent fissure condylomata and gummatous ulceration at the anal margin, and also from tuberculous infiltration of the anal canal.

Treatment.—This consists in early and free removal. In all cases, whether obviously enlarged or not the inguinal glands of both groins must be freely removed. If the growth is quite small, it may be possible to remove it with a sufficient margin of healthy tissue, so that the sphincter muscle may be preserved. This leaves a wound which in healing would distort the anal margin and render the external sphincter muscle incompetent. To obviate this, at the time of operation a flap of skin from the buttock, pedicled at each end, may be transposed and sutured to the anal margin. If the removal of the growth necessitates removal of the external sphincter muscle, in whole or in part, a *permanent inguinal colostomy should be performed, and the* rectum be removed as described in the perineal operation for rectal cancer (p 741)

PRURITUS ANI

Pruritus is a symptom, not a disease. Pruritus ani is the term used for itching of the skin around the anus and anal canal.

Etiology and varieties.—1. *Constitutional disorders*, e.g. gout, diabetes, rheumatism, may cause pruritus. Over-eating, or over-indulgence in alcohol, may so derange the liver and impede the portal circulation that the hæmorrhoidal veins may become congested, causing temporary pruritus. Such disorders will greatly aggravate a pre-existing pruritus ani.

2. *Local irritation and diseases.*—Pruritus may be caused by oxyurides, not only in the child, but in adult life also. It may be due also to want of proper cleanliness in the anal region. The discharges from fistulæ, fissures, ulcers in the anal canal, internal hæmorrhoids, or proctitis from whatever cause, may be responsible for the itching. Pruritus may be present with redundant circumanal folds, or hypertrophied anal papillæ, and may arise from the unconscious escape of mucus, owing to weakness of the sphincters, whether natural to the patient or due to prolapse or previous operation. It may also be caused by irritating discharges from the genitalia.

3. Pruritus ani may be present in the absence of any recognized constitutional disorder or local disease. The etiology of such cases is obscure.

A bacterial origin has been suggested by Dr Dwight Murray and he and others have found the *Streptococcus fecalis* in the diseased skin in many cases. This infection may of course, be secondary. Pruritus is regarded by some as a primary lesion of the nerve-endings in the skin. It is impossible to say whether such disease of the nerve-endings is primary or is secondary to a local infection.

Symptoms.—Pruritus is variable in degree. It is liable to exacerbations. In advanced cases the itching is intolerable rendering the patients very depressed and at times suicidal. It varies from day to day and from week to week; it is worse at night time, and aggravated by worry and any condition which depresses the general health.

When the pruritus has been present for some time the affected area of the skin shows the result of scratching to relieve the condition. The skin becomes inflamed and reddened, and exhibits cracks, fissures, and ulcers, the result of secondary pyogenic infection. In some old-standing cases the skin may become thin, pale and atrophic, with superficial fissures and excoriations.

Treatment.—The first essential is to make a thorough examination of the rectum and anal canal, preferably under general anesthesia. The more thoroughly this is done, the more often will a local cause be revealed. If the case be seen early and a local cause discovered and treated a favourable prognosis may be given, but if the pruritus is of long standing it is very unwise to promise any beneficial result from local treatment of the original cause, for the associated inflammation may have extended to the nerve-endings and have there caused irreparable damage. Constitutional disorders, oxyurides, and errors in diet must be treated. Strict cleanliness of the anal region must be enforced. If no constitutional or local cause be discovered, or the pruritus continues after the cure of the local cause, local applications for the relief of the itching are necessary. No definite rules can be formulated. As in all cases of pruritus, what will suit one case may be harmful to another. Lotions are generally preferable to ointments. Preparations containing carbolic acid, salicylic acid, belladonna, subacetate of lead, bismuth subnitrate, ichthyol, menthol, tar etc. may be tried in turn.

Acting on the assumption that the condition is caused by a bacterial infection, vaccine treatment has been employed, but has met with very little success.

Ionization with zinc or cocaine may relieve some cases; radium has benefited others. But X ray treatment seems superior to both; it must be applied carefully for fear of causing an X ray burn, and should not be persevered with if improvement does not immediately follow.

Should there be no adequate relief from such agencies as those mentioned, recourse must be had to operative measures. In 1906 Sir Charles Ball devised an operation for the division of all the nerves of the affected area—an operation known by his name. Ball's operation is performed by making a curved incision on each side of the affected area, enclosing the entire ellipse with the exception of a narrow neck in front and behind. The skin flaps are raised over the external sphincter extending up the anal canal to above the internal sphincter muscles. The pedicles in front and behind are undercut to a point beyond the area of irritation, and the outer concave edges of the incision are undercut for a short distance. If the operation has been carefully done without button-holing the flaps or endangering their blood supply and all hemorrhage has been carefully arrested, primary union will result after suture of the flaps, and the whole area of affected skin will be rendered anesthetic. Sensation will return in a few weeks, but the pruritus should be completely

relieved. A return of the trouble in localized patches is generally held to be due to an error in operative technique, some nerves not having been completely divided, from failure to raise the flaps sufficiently far up the anal canal. In such cases the operation may be repeated with success.

SELECTED BIBLIOGRAPHY

Anderson "The After Result of the Operative Treatment of Hæmorrhoids," *Brit. Med. Journ.*, 1909.

Bland-Sutton, *Tumours, Innocent and Malignant*, 7th edit. Coccygeal Sinuses.

Bruce, "The Treatment of Ulcerative Proctitis by Zinc Kataphoresis," *Proc. Roy Soc. Med.*, 1908.

Cheatle, "The Spread of Cancer in the Lower Part of the Large Intestine," *Brit. Med. Journ.*, 1914.

Cole, Percival, "The Intramural Spread of Rectal Carcinoma," *ibid.*, 1913.

Eden, "Recto-vaginal Fistulæ," *Proc. Roy Soc. Med.*

Gordon-Watson, and others, Discussion on Treatment of Hæmorrhoids, Annual Meeting, British Medical Association, 1921

Handley "Surgery of the Lymphatic System," Hunterian Lectures, *Brit. Med. Journ.*, 1910.

Hartman, "Stricture of the Rectum," *Med. Soc. Trans.*, 1921.

Keith, "*Malformations of the Hind End of the Body*" *Brit. Med. Journ.* 1908.

Lockhart Mummery "Prolapse of Rectum," *Lancet*, 1910; "Coccygeal Fistulæ" *Brit. Med. Journ.*, 1921

Miles, "A Method of performing Abdomino-Perineal Excision for Carcinoma of the Rectum and of the Terminal Part of the Pelvic Colon," *Lancet*, 1908; "*The Radical Abdomino-Perineal Operation for Cancer of the Rectum* and of the Pelvic Colon," *Brit. Med. Journ.*, 1910; "The Abdomino-Perineal Operation for Cancer of the Rectum, *Brit. Journ. Surg.*, 1913; "Observations upon Internal Piles, *Surg., Gyn., and Obstet.*, 1919.

Moschowitz, "Prolapse of Rectum," *New York State Journ. of Med.*, 1912.

de Mula, "*Hæmorrhoids in Children*," *Arch. of Pediatrics*, 1905.

Murray, Dwight, "Pruritus Ani," *Proc. Amer Proct. Soc.* 1912.

Proceedings of Royal Society of Medicine, Subsection of Proctology Papers, Discussions, Specimens, etc., 1911–1921

Wood-Jones, "The Nature of the Malformations of the Rectum and Uro-Genital Passages," *Brit. Med Journ.*, 1904.

Zésas, "Les Hémorroïdes chez l Enfant," *Arch. Gén. de Chir* 1908.

THE LIVER, GALL-BLADDER, BILE PASSAGES, AND PANCREAS

By G GREY TURNER, M S. F R C S

Anatomy of the liver and of the biliary apparatus. —The liver measures a little more than 6 in. in the greatest vertical direction, and a little less than 6 in. antero-posteriorly Its summit reaches to the upper border of the right 5th rib at a point 1 in. internal to the mammary line, and therefore, is not directly accessible without traversing the pleura lung and diaphragm. Some part of each of the 6th 7th, 8th 9th 10th, and 11th ribs lies over

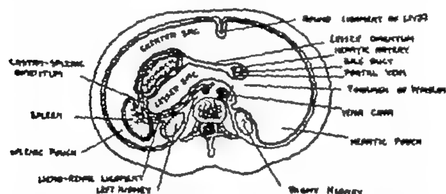


Fig 515.—Transverse section of the peritoneal cavity at level of foramen of Winslow

the liver as well as the cartilages from the 6th to the 9th, while the pleura extends to within 2 in. of the costal margin in the anterior axillary line.

It is a heavy organ, weighing on an average 3 lb. The consistence is that of a soft solid, which is surrounded by a tough capsule, and when the latter is torn it easily friable. The liver is possessed of considerable mobility especially round a transverse axis, and it can be so rotated that the anterior surface and edge pass up under the costal margin, thus bringing the region of the hilus with the vessels and bile-ducts nearer the surface. The position of the liver varies in different individuals In those with long, narrow chests it lies high up, hidden beneath the dome of the right half of the diaphragm, while in the broad-chested it is much lower It is an extremely vascular organ, and during life about half its bulk is made up of the blood in

its vessels. The veins are adherent to the walls of the canals in which they lie and are unprovided with valves, so that they bleed copiously when divided.

The peritoneal space just below the liver—the hepatic pouch (Fig. 515)—is important, for here collections may form when the gall-bladder leaks. It can be most effectually drained through the posterior end of a transverse incision.

The **gall bladder** (Fig 516) is usually pear-shaped, and has a capacity of 1½ oz. At its junction with the cystic duct there is often a lateral pouching called the pelvis, or Hartmann's pouch, which, when distended, may be mistaken for the commencement of the cystic duct. The gall-bladder is

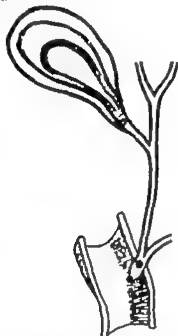


Fig 510.—Diagram of the gall bladder and bile-ducts.

The black outlines represent the normal condition; red indicates calculus impacted in the cystic duct, with consequent distension of the gall-bladder but no jaundice; and green, stone in the lower end of the common duct, with contracted and thickened gall bladder and deep jaundice.

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direct contact with it. In the angle between the cystic and the hepatic ducts and by the side of the common ducts, lymphatic glands are constantly present; when enlarged, and especially if they are calcified, they may closely simulate calculi.

The common hepatic duct is about 1½ in. in length, while the **common bile-duct** is about 3 in. long and $\frac{3}{16}$ in. in diameter and may conveniently be divided into three portions. The *first or supraduodenal portion* extends to the upper border of the duodenum, in the free edge of the gastro-hepatic omentum, and is about 1½ in. long. Behind it lies the portal vein, and to its inner side the hepatic artery. This portion of the duct is often in relation with one or two lymphatic glands, and small veins or an arterial twig may cross it and be the source of serious hæmorrhage if wounded. The *second or retroduodenal portion* is 1 in. to 1½ in. long, and in two cases out of three is more or less surrounded by pancreas. The *third or transduodenal portion*, about ¾ in. long, passes obliquely through the duodenal wall and ends in the ampulla of Vater, which opens into the bowel on a papilla, after being joined by the main duct of the pancreas. The common duct gradually diminishes in diameter from ¼ in. at the beginning to ⅛ in. at its orifice.

The wall of the gall bladder contains a well marked layer of plain muscle-fibres, mostly disposed in a longitudinal direction. The ducts have much less muscular tissue, which is arranged in a circular fashion and is collected at the lower end of the common duct to form a muscle known as the "sphincter of Oddi." Both bladder and ducts are lined by columnar epithelium with many mucous glands. From 1½ to 2 pints of bile is secreted in twenty four hours.

Variations of the gall bladder and bile-ducts. — These occur with sufficient frequency to be of importance when surgical interference is necessary. The gall bladder may be entirely absent or present on the under surface of the left lobe, or it may be in its normal situation but completely embedded in the liver substance, or it may be hour-glass, or bifid, or even double. The ducts present endless variations, the most important being (1) a long cystic duct running parallel to the common duct for a considerable distance; (2) a very short cystic duct; (3) various spiral forms in which the cystic duct winds round the hepatic ducts before uniting with them; (4) variations in the methods of union of the hepatic ducts; (5) hepatic ducts uniting much lower than usual, or opening separately into the duodenum; (6) hepatic ducts opening directly into the gall bladder and the common duct originating from the latter; (7) the presence of accessory hepatic ducts opening directly into the gall-bladder.

The relations of the hepatic artery and its branches are also very variable.

THE LIVER

Methods of examination.—To the ordinary methods must be added the use of the X rays with or without the inflation of the peritoneal cavity with oxygen. The observation with the fluorescent screen of the shape of the dome of the liver and its relations to the right half of the diaphragm often affords valuable information.

MALFORMATIONS AND MISPLACEMENTS

As a result of constriction by corsets and belts, the liver may be pushed up or may be flattened antero-posteriorly with downward elongation of the whole of the right lobe, or of its lower border



Fig 518.—Tropical abscess of the liver showing two distinct cavities separated by a strong septum. The uppermost abscess extended to the surface giving rise to fatal peritonitis.

abscess. Pain is a constant feature it may be dull and over the liver region, or may be referred to the acromion. There is often a tendency to stoop to the right, and perhaps coughing on deep inspiration. The temperature may be continuously elevated or regularly variable, simulating malaria or it may show a spike associated with a rigor or it may be very little elevated, and in some chronic cases may be normal or subnormal. The pulse-rate is relatively slow 100 to 110 Sweating is usually profuse, the skin yellowish and earthy and wasting pronounced. Leucocytosis is usually present, except in very chronic abscesses with thick walls.

Physical signs.—The liver is enlarged, usually upwards, producing dullness almost as high as the scapular angle. The whole hepatic region is commonly slightly bulged and, later tender on deep pressure When the abscess extends downwards a rounded lump may be felt below the liver margin. Limitation of movement of the lower part of the right chest with some crepitations and a pleural rub are often present. Screen examination usually shows the upward enlargement of the liver and limited excursion of the right half of the diaphragm

Diagnosis.—From malaria, diagnosis is made by blood examination and by the effect of quinine. The upward enlargement of the liver is unlike that seen in suppurating gall bladder and in cancer but it may be very difficult to distinguish the condition from suppurating hydatid, gumma, or subdiaphragmatic abscess. *Amœbic hepatitis* is very confusing. It may occur either during acute attacks of dysentery or at some period remote. The liver is generally enlarged and there are pain, fever and leucocytosis The diagnosis is made by the therapeutic test of emetine One grain is given daily by intramuscular injection and if the condition is only hepatitis all the symptoms are rapidly and completely relieved. The fluorescent screen may give valuable help as also may an examination of the fæces for amœbæ. The diagnosis is rendered more certain by the use of the exploring needle. It is necessary to emphasize the ease with which even a large abscess may be missed unless the exploration is very thorough. A constant vacuum should be kept in the syringe attached to the needle which may with safety be 3½ in. long The finding of the abscess should be immediately followed by operation the needle being left *in situ* as a guide. Amœbæ may be found in the fluid, but prolonged search is often necessary though they are usually numerous in the discharge from the abscess on the days following the operation a warmed stage is helpful.

Prognosis.—The use of emetine has much improved the outlook. Without operation the prognosis is bad and surgical treatment has a mortality of about 10 per cent.

Treatment—Whenever the circumstances will allow a course of emetine should be given before the operation, and this drug should always be used during convalescence. One grain a day by intra muscular injection for ten days is a suitable course. In the few cases in which the abscess is actually invading the skin a simple incision, followed by drainage through a very large tube, will effect cure. Many successful results have been reported from repeated aspiration, while at the same time energetic treatment with emetine is pursued. Manson, Cantlie, and Rogers have used cannula drainage carried out immediately after the presence and site of the abscess have been determined by exploratory puncture, and this method has also been attended by very good results. For surgeons who have no special experience of these cases the open operation is probably the best.

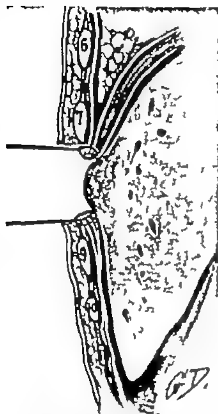


Fig 519—Operation of trans pleural hepatotomy

A portion of the 8th rib has been removed. The sutures which fix the diaphragm to the parietal tissues are left long for use as tractors.

An abscess in the hepatic dome is best approached by excision of part of the 8th or 9th rib just behind the mid-axillary line (Fig 519). It is best to approximate the costal to the diaphragmatic pleura by stitching. The ends of the two catgut sutures, which are usually all that is necessary are left long, and drawn outwards while the diaphragm is incised. In this way the sudden entrance of air or pus into the pleura is prevented. The same result may be obtained by packing a ring of gauze between chest wall and parietal pleura, so as to press the latter down on to the diaphragmatic pleura. In very many cases the pleura and peritoneum along the operative track are found to be already adherent.

When the principal enlargement is downwards the abdomen should be opened by a vertical incision over the prominent part through the right rectus muscle. If the adhesions are not sufficient, the peritoneum should be protected by gauze packing. The abscess is

then opened by forceps, and the finger introduced and any secondary abscesses opened Drainage is secured by a large rubber tube, 1 in in diameter wrapped round with gauze to prevent pus oozing up by its sides before the liver adheres to the parietes. During the first two days the pus should be sterile and after that should only contain amœbæ. Every care must be taken to avoid secondary infection, if the abscess is to close rapidly As a rule the cavity rapidly contracts but the hepatic enlargement may only slowly decrease It is often necessary to aid drainage of large cavities by initiating a siphon action through the tube. Sometimes there may be a considerable discharge of bile which only ceases gradually

INFECTIVE GRANULOMATA

Tuberculosis of the liver is rare. It may take the form of solitary masses, and localized abscesses have been operated upon successfully The liver may be enlarged, and there is pyrexia and often jaundice, but usually there are no distinctive diagnostic features. The presence of tuberculosis elsewhere is suggestive.

Actinomycosis is sometimes met with when not expected though it is undoubtedly rare. It is probably always secondary to the disease elsewhere in the abdomen, though the liver involvement may be the first manifestation of the disease clinically There may be pain, localized tenderness, and enlargement, with pyrexia, simulating suppurating gall bladder or hepato-pouch appendicitis Operation discloses localized enlargement studded with small yellow areas very like the appearances seen in pylephlebitis.

The **prognosis** is bad, for abdominal dissemination nearly always occurs and proves fatal.

Treatment —Broken-down areas can be dealt with by the sharp spoon, but the general measures for this disease (see Vol. I., p. 917) are the most important.

Syphilis.—Only the tertiary manifestations are of surgical interest.

Gummata, either single or multiple, may occur often as late as five to twenty years after infection. They form yellowish masses accompanied by perihepatitis, and sometimes by diffuse sclerosis and lardaceous disease. The *dome* of the right lobe is most commonly affected, and the diaphragm often invaded. Another *common site* is near the portal fissure, and they may also occur in the left lobe and form epigastric tumours simulating cancer of the stomach. When multiple, their appearance is characteristic. Each mass is about the size of a walnut, is rounded and projects on the surface of the organ, and is not umbilicated like a nodule of cancer and there is always evidence of localized inflammation in the vicinity Gummata

Treatment.—Whenever the circumstances will allow a course of emetine should be given before the operation and this drug should always be used during convalescence. One grain a day by intra muscular injection for ten days is a suitable course. In the few cases in which the abscess is actually invading the skin a simple incision, followed by drainage through a very large tube will effect cure. Many successful results have been reported from repeated aspiration while at the same time energetic treatment with emetine is pursued. Manson, Canthe, and Rogers have used cannula drainage carried out immediately after the presence and site of the abscess have been determined by exploratory puncture, and this method has also been attended by very good results. For surgeons who have no special experience of these cases the open operation is probably the best.

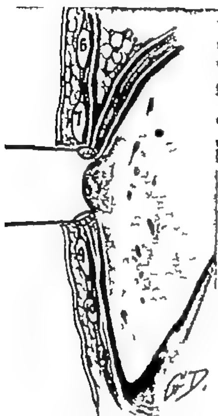


Fig 519.—Operation of trans pleural hepatotomy

A portion of the 8th rib has been removed. The sutures which fix the diaphragm to the parietal tissues are left long for use as tractors.

An abscess in the hepatic dome is best approached by excision of part of the 8th or 9th rib just behind the mid-axillary line (Fig. 519) It is best to approximate the costal to the *diaphragmatic pleura by stitching.* The ends of the two catgut sutures, which are usually all that is necessary are left long, and drawn outwards while the diaphragm is incised. In this way the sudden entrance of air or pus into the pleura is prevented. The same result may be obtained by packing a ring of gauze between chest wall and parietal pleura, so as to press the latter down on to the diaphragmatic pleura. In very many cases the pleura and peritoneum along the operative track are found to be already adherent.

When the principal enlargement is downwards the abdomen should be opened by a vertical incision over the prominent part through the right rectus muscle. If the adhesions are not sufficient, the peritoneum should be protected by gauze packing The abscess is

then opened by forceps, and the finger introduced and any secondary abscesses opened. Drainage is secured by a large rubber tube 1 in in diameter wrapped round with gauze to prevent pus oozing up by its sides before the liver adheres to the parietes. During the first two days the pus should be sterile, and after that should only contain amoebæ. Every care must be taken to avoid secondary infection, if the abscess is to close rapidly. As a rule the cavity rapidly contracts but the hepatic enlargement may only slowly decrease. It is often necessary to aid drainage of large cavities by initiating a siphon action through the tube. Sometimes there may be a considerable discharge of bile which only ceases gradually.

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have a tendency to be limited to one area of the liver and thus may be pedunculated. Such a localized area has several times been mistaken for a primary new growth They may become absorbed, leaving scars which by their contraction tend to cause syphilitic cicatrization or even lobulation of the liver or they may break down, become infected and simulate abscesses. In another form or at a later stage a syphilitic cirrhosis develops, with ascites as a prominent feature.

Clinical features.—There is usually complaint of localized pain and tenderness with some general failure of health Pyrexia suggests softening of the gummata Jaundice is rare, but ascites may be present if the gumma obstructs the portal vein.

Diagnosis has to be made from carcinoma. Gummata occur at an earlier age the history may be suggestive. A positive Wassermann reaction and the effect of antisyphilitic measures will probably settle the question.

Treatment.—Exploration may be advised in cases that have resisted medical treatment. If the diagnosis is confirmed the abdomen may be closed and remedies persevered with, but when there is doubt the mass may be excised or opened and some tissue scooped out for examination. This interference may hasten the effect of the appropriate therapeutic measures described in Vol I p 801 *et seq*

CIRRHOSIS

For the treatment of the ascites due to this disease an operation now generally known as *omentopexy* (Fig 520) was devised independently by Talma of Utrecht, and Drummond and Morison of Newcastle-upon Tyne and first successfully practised by Morison in 1895 This operation aims at establishing an efficient collateral venous circulation between the abdominal wall and the omentum and viscera, thus helping to carry off the portal blood. That this does actually occur is proved by the great development of the subcutaneous veins some time after the operation.

The operation can only be recommended for ascites depending on cirrhosis and due to portal obstruction, and *not merely the result* of toxæmia The patients selected should have withstood several tappings, should be *free from pulmonary cardiac, or renal disease*, and should become absolute abstainers after recovery To perform *the operation properly a general anæsthetic is necessary*

A supra umbilical incision is made to expose the liver and spleen and confirm the diagnosis, care being taken not to divide the round ligament with its vessels. Then through a small suprapubic opening a Keith s tube is introduced into Douglas s pouch and the abdomen emptied of fluid The surfaces of the liver and spleen are scrubbed with gauze to set up some peritoneal reaction and encourage the

formation of vascular adhesions and the omentum is fixed at two or three points to the parietes, especially to the peritoneal edges of the wound. Afterwards the parietes are kept in contact with the liver and spleen by carefully strapping the abdomen from above downwards. Continuous drainage is secured by the Keith's tube. Reaccumulation of fluid may demand one or more tappings. Some operators dispense with drainage and rely upon subsequent tapping.

Results.—In properly selected cases the mortality is very low and the after results are uniformly good, patients remaining alive and well for 2, 3, 5, 6, 11 and over 15 years. (*See* Fig. 520.)

Other operations for the treatment of ascites have been devised. Drainage into the subcutaneous tissue of the thigh through the femoral canal has been suggested by Essex Wynter and carried out by Sampson Handley, and in suitable cases has given very good and apparently lasting results. A similar method of subcutaneous drainage into the abdominal wall has also been devised and carried out by Peter Paterson of Glasgow with equally encouraging results. Other operations aim at relieving more directly the portal congestion. For this purpose anastomosis between the portal vein and vena cava (Eck's fistula) has been made, but the results were unsatisfactory and did not encourage further use of the method. The Mayos have employed splenectomy to divert the large volume of blood which would normally reach the liver by the splenic vein, and also on the assumption that the cirrhosis may be secondary to metabolic poisons derived from the spleen. The results have been encouraging. This operation may easily be combined with omentopexy.



Fig. 520.—Photograph of a patient alive and well 11 years after omentopexy for alcoholic cirrhosis.

The great development of the epigastric veins is well shown on the right side. That similar condition did not arise on the left side was probably due to the fact that the patient always [illegible] or an inguinal truss.

(*Photograph kindly lent by Professor Rutherford Morison.*)

SIMPLE TUMOURS

Angiomas of the liver have several times been successfully removed. Though usually quite small, this species of tumour may

attain the size of a child's head. As operative interference may be very dangerous, and as there is no special tendency to become malignant, these tumours are best left alone unless there is some distinct indication for removal. If an attempt is made at excision the surgeon must take the greatest care to cut through the normal liver well away from the very vascular tumour.

Adenomas.—The multiple variety which is usually associated



Fig. 521.—Portion of a liver with the gall bladder weighing over 2 lb. and containing a large hepatoma.

Removed by operation from a boy of 13 years. The patient made a good recovery and was alive and well 24 months later.

with cirrhosis is not amenable to surgical interference. Localized tumours arise from the liver cells, the intrahepatic bile-ducts, or adrenal rests in the liver substance. Some so closely resemble liver tissue that they are spoken of as hepatomas. These tumours are not uncommonly found after death but have rarely been diagnosed before. Some few cases are on record in which they have been observed during the course of operations on the bile passages. Very

rarely they may be associated with pain or may become obtrusive because of their size (Fig 521) In the latter event they have often become cystic.

Treatment —If they are causing symptoms or increasing rapidly the possibility of excision should be considered. An operation of this sort must not be undertaken until a most careful preliminary examination (after the abdomen is opened) has shown that it is possible to get well beyond the limits of the disease without encroaching on the hilum or an inaccessible part of the organ Though some such tumours may be easily enucleated it will usually be necessary to carry out a formal excision The tumour from which Fig 521 was drawn

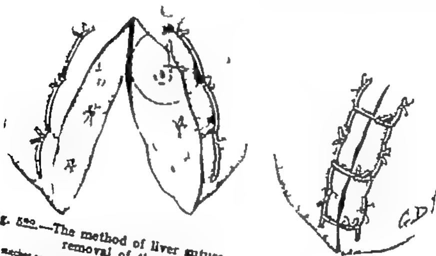


Fig. 522.—The method of liver suture employed in the operation for removal of the tumour shown in Fig 521

The stitches [illegible] of [illegible] and are passed with [illegible] full curved round needle. [illegible] the left-hand figure a divided vein is shown surrounded by [illegible] purse-string suture to control haemorrhage

was excised from a boy aged 13. A wedge was made and the edges were drawn together (Fig. 522) A good recovery followed.

MALIGNANT TUMOURS

Of the malignant tumours, the only important variety from an operative point of view is that which arises as an extension from malignant disease of the gall bladder (see p 792)

Primary carcinoma and **sarcoma** of the liver though rare, are important because they may occur in the form of massive growth which may degenerate and simulate a cyst an abscess, or a gumma. The right lobe is usually the one affected, the growth forming a single large tumour. Sarcoma is even rarer than carcinoma.

Secondary carcinoma and **sarcoma** are more common, and the growths are generally multiple and of various sizes.

Treatment.—When the diagnosis of secondary malignant disease is established, operative interference is out of the question, but exploration is certainly justified with a doubtful localised tumour for many inflammatory conditions are indistinguishable from new growth. If as is usual, radical operation is not feasible, the patient should be given the chance that a course of iodide and mercury may offer

The liver may also be invaded by **direct extension of malignant growths** from the gall-bladder stomach, or colon Such extensions do not necessarily preclude surgical interference, but this should not be undertaken unless the full extent of the involvement can first be ascertained.

Tumours in the ligaments of the liver.—Isolated cysts and solid tumours—in one case a hypernephroma—have been found in the round ligament and in the falciform ligament. They are usually discovered unexpectedly in the course of an operation, and may often be successfully removed

CYSTS

Simple single cysts are rarely found. Though usually small they may attain the size of a child's head. They are, as a rule, situated near the free margin of the liver and have been found in connexion with the round ligament. They occur at all ages, and are much more common in the female sex. They tend steadily to increase in size, and sometimes very rapidly Symptoms and clinical signs depend on the size and situation but in most cases the presence of a lump is the principal feature.

Treatment.—Excision is the ideal plan but partial removal or drainage may be the only feasible operation, and has often been successful

Cystadenomas and **multiple cystic disease** also occur though they are very rare. The latter is almost constantly associated with the same disease affecting the kidneys and other viscera.

Hydatids

For a general description of these parasites, see Vol. I., p 632. The cysts occur in the liver more frequently than in all other situations put together (63 4 per cent) The disease manifests itself between the ages of 20 and 40 but, though uncommon, cases are met with in children, usually from 8 to 10 years of age.

Pathology morbid anatomy.—The tumour is usually situated in the right lobe, either deeply embedded *or pointing towards* the upper surface. The cyst may be single there may be two of

about the same size or numbers of small cysts may be present (the multilocular variety)

The true cyst is composed of two layers, which together form the mother cyst an outer whitish firm cuticle and an inner cellular layer from which the scolices develop These two layers are surrounded by a fibrous capsule or adventitious cyst, formed by an alteration of the adjoining parts. The scolices possess suckers and hooklets, and though at first attached to the capsule later float free in the cyst. The fluid is clear often opalescent of specific gravity 1008 to 1010 and, when the cyst shows active growth contains no albumin Hooklets may be found in the fluid but are not numerous. The cysts are often multiple not only in the liver but in other parts of the body Before deciding on the plan of treatment a thorough search for such other cysts must be made, and for this purpose the X-rays may be helpful.

Progress and secondary changes.—The growth of the cyst may be very slow and it may be five or more years before any urgent symptoms arise. Many hydatids die and are found, often accidentally or after death, with thick calcified walls and shrivelled inspissated contents On the other hand they may disseminate and are especially liable to invade the peritoneum or the pleura Rupture may follow slight trauma or gradual erosion. When this occurs into the peritoneal cavity it is attended by characteristic features, viz (1) peritonitis with effusion (2) marked eosinophilia and (3) urticaria which is probably an anaphylactic phenomenon. Suppuration is common, and may be determined by injury The infection may come from the bile or some adjacent hollow viscus or may be hæmic as in typhoid fever When bile finds its way into the cyst as by erosion of the bile-ducts, the parasite dies.

Clinical features.—Hydatid cysts usually obtrude themselves on account of their size but they may be very large without giving rise to injurious pressure on neighbouring organs. The patient may complain of dragging or a feeling of weight or of attacks of pain depending on peritonitis or suppuration.

Physical signs.—As a rule the liver is enlarged upwards and may compress the lung and also cause bulging of the costal arch. When the cyst can be felt below the costal margin it is dull and usually very tense and elastic, so much so that it may resemble a solid tumour it rarely presents the so-called hydatid thrill Marked tenderness jaundice and ascites when present are usually due to inflammatory changes, or to pressure on bile-ducts portal vein, or inferior vena cava. Both jaundice and ascites are rare

Diagnosis.—Malignant disease and cirrhosis syphilis suppuration and hepatoptosis may each be mistaken for hydatids, and even at

operation multilocular hydatids may be difficult to diagnose from cancer. When the hydatid enlarges the liver upwards, pleural effusion or hydatid disease in the lung may be simulated. In these circumstances skiagraphy may help, the fluorescent screen clearly showing the diaphragm and its movements. Sometimes the cyst and even the daughter-cysts may be seen on a good plate. Exploratory puncture should *not* be done when the presence of hydatids is suspected.

Many attempts have been made during the last few years to devise and improve laboratory methods for the diagnosis of hydatids. Weinberg relies on the deviation of the complement, and has found the reaction positive in a large proportion of cases. Eosinophilia occurs in about 75 per cent. of cases, but it also occurs with other vermiform parasites. A precipitin reaction and a cutaneous reaction can sometimes be obtained. It must be clearly realized that these methods are only supplementary to clinical evidence, and in actual practice are not very reliable. Many observers think that X ray examination is the most useful aid to diagnosis.

Prognosis.—Hydatid disease is always potentially serious. Although natural death of the parasite may occur, the cyst may burst and disseminate, or become infected. Perforation into the peritoneum or pleura is often attended with fatal results, but rupture into the stomach, duodenum, or bile-passages is less disastrous and may even result in cure.

Treatment.—As hydatids which are diagnosable are so frequently progressive, the presence of a cyst is sufficient indication for operation, which has superseded all other methods. The essential thing is to remove the mother-cyst and to deal with the adventitious capsule as best possible. Cysts that project downwards are most safely reached through an abdominal incision, while for those that occupy the dome of the liver, and that cannot be satisfactorily reached from the abdomen, the thoracic route must be chosen, an incision being made in the 8th or 9th interspace. It is necessary to protect the surrounding parts from contamination by the fluid, for fear of secondary implantation. This may be done by gauze packing, or by stitching the sac to the abdominal wound before opening it. Some surgeons prefer to divide the operation of evacuation into two stages, leaving the opening of the sac to a second sitting ten days later.

Though complete excision is the ideal operation, it can seldom be safely carried out, as the adventitious capsule is so intimately associated with the surrounding parts. Enucleation of the true cyst may sometimes be combined with partial excision of the capsule. The large area left after excision or enucleation may be completely or partially closed by tier sutures, any part not so closed

being treated by gauze packing. In any case drainage must be provided.

If excision is not expedient the cyst should be opened and emptied, and every part of the lining membrane removed by forceps or by gauze scrubbing. The remaining cavity must be packed if there is much hæmorrhage, and in all cases freely drained. This method must be looked upon as the normal procedure in the great majority of cases.

Very large tumours, of which the whole interior cannot be reached should be marsupialized by stitching the edges to the peritoneum or fascia of the parietal wound. The interior may then be packed and drained.

Attempts to sterilize hydatids have been made by injecting a solution of 1 per-cent. formalin ten days before operation. If this has not been done it is recommended to pack gauze soaked in this solution round about the cyst before it is opened so that any fluid which escapes may be rendered innocuous.

The **results of operations for hydatids of the liver** are very good if the cases are taken early and treated rationally. Complications and the presence of hydatids in other organs account for most of the mortality but the gravity of surgical intervention is greatly increased if excision is performed in unsuitable cases.

Recurrence.—Latent cysts may account for recurrences months or years after successful treatment, and in hydatid countries reinfection is always possible.

GALL-BLADDER AND BILE-DUCTS

MALFORMATIONS

Certain anatomical variations which may be of importance when surgical intervention is contemplated have already been described in the section on Anatomy (p. 749).

Congenital Obliteration of the Bile Ducts

This condition is probably due to antenatal descending cholangitis. Clinically there is jaundice either at birth or very soon afterwards; this rapidly increases and becomes associated with cholæmia and tendency to hæmorrhage, life seldom being prolonged beyond six months.

Treatment.—In cases that have survived infancy an operation may be undertaken. If the gall-bladder is not distended with bile cholecystenterostomy will be useless and an attempt will have to be made to unite a dilated duct or a portion of the cut surface of the liver to the small intestine.

Cystic Dilatation of the Common Bile-Duct

There are two classes of cases: (*a*) those with a free opening into the duodenum; (*b*) those with definite obstruction in the common duct. The first variety is often a diverticulum of the duct, and of congenital origin. It is much more frequent in the female, and gives rise to symptoms at an average age of between 15 and 16 years, though it may be *middle life before trouble begins. The dilatation varies* in size and is sometimes enormous, holding a pint or more of bile. Clinically there is a large cyst below the liver associated with jaundice. The onset is gradual and with little or no pain.

Treatment must be operative, usually by anastomosing the *cyst to some part of the intestine, preferably the duodenum.* The mortality is very high, but it could probably be much reduced if operative treatment were divided into stages—first, drainage until jaundice and tendency to cholæmia disappear; and secondly some type of anastomosis.

INJURIES

The gall-bladder may be ruptured subcutaneously or wounded by a stab or a bullet. A large bile-duct may be damaged and there may be associated injuries to the liver or other viscera or to some *large vessel such as the portal vein. Existing disease of the biliary* tract predisposes it to injury.

Morbid anatomy.—The rent in the gall bladder is usually at the fundus and may be a mere puncture or a tear an inch or more in length. The ducts may be completely torn across, but more usually only part of the circumference is involved, so that healing occurs though stricture may follow.

Clinical features.—This accident may be early fatal from associated injury and, in any case, will be attended with shock. When the shock passes off the patient may appear to recover completely, or the abdomen may become distended, painful, tender, rigid and dull in the right side, especially about the iliac region. Jaundice is of diagnostic importance, for it is present in [illegible] per cent. of injuries to the bile-passages, and only in 4.75 per cent. of injuries to the liver. Wasting is also a marked feature. The condition may go on to a low form of septic peritonitis, which soon proves fatal, or after a time the general abdominal distension diminishes, but is followed either at once or in two or three weeks by the development of a localized collection of fluid in the right side. Persistence of bile in the fæces is a sign that the continuity of the common duct is not completely interrupted.

Treatment.—If an injury to the bile-passages is diagnosed early an operation should be carried out. A rent in the fundus of the

gall-bladder may be closed by suture or used for purposes of drainage or the viscus may be removed. If one of the larger ducts is injured, the treatment will depend on the size of the tear A small hole may be treated by *stitching a tube to the margin of the rent thus providing* for external drainage but almost complete division demands an attempt at suture combined with external drainage.

In complete rupture of the common duct it may be possible to reunite the ends, or to bridge the gap by a rubber tube passed into either end and *left in situ* or *it may be necessary to implant* the proximal end into the duodenum Owing to difficulties due to adhesions etc. especially when the intervention is not carried out immediately after the accident, it may be safer and easier to ligature both ends and to perform cholecystenterostomy (Terrier)

In cases not seen until a localised collection has formed it is best merely to establish external drainage without attempting to find the hole in the duct In these circumstances an oblique or transverse incision is the most suitable as it provides such good drainage of the hepatic pouch.

INFECTIVE GRANULOMATA

Tuberculosis, whether of the gall bladder or of the ducts though found after death in a fair proportion of cases of intestinal tuberculosis, is undoubtedly very rare as a clinical entity The gall bladder has been *opened for suspected calculi and found to contain* only tuberculous granulation tissue.

Diagnosis is practically impossible though singularly jaundice has always been absent. The **treatment** consists either in excision of the gall-bladder or in thorough curettage with use of pure carbolic acid, etc.

Calcareous tuberculous glands along the cystic or common ducts may simulate gall-stones.

Syphilis.—Sometimes gummata or syphilitic cicatrices have caused obstruction of the common duct and given rise to symptoms of gall-stones, while a gumma in the margin of the liver may *suggest* a similar diagnosis. Cases with a strong syphilitic history should be given a course of mercury and potassium iodide before operation is performed.

INFECTIONS

Bacteriology of biliary passages.—It is usually supposed that normal bile is sterile but some investigators have demonstrated bacterial life when there has been no sign of disease. It is probably a question of the time at which the inoculations are made organisms being active and quiescent by turns. In infected cases

the commonest organism is said to be the B. coli, next the B. typhosus, and afterwards the staphylococcus, pneumococcus, and streptococcus, but the researches of Rosenow have shown a large *preponderance of streptococcal infections. This observer has also* stated that organisms may be grown from the wall of the gall-bladder when the contained bile has been sterile.

The usual route by which infection occurs is the portal blood stream but it may be by direct spread up the common bile-duct, by the systemic circulation, or by the lymphatics.

CHOLECYSTITIS

Cholecystitis is much commoner than cholangitis, owing to the readier drainage of the ducts into the intestine.

Cholecystitis, though usually associated with gall-stones, may occur independently and there is evidence to show that such infections may exist for some time before gall-stones appear

This is borne out by a series of the Mayos' cases of cholecystectomy In 365 cases, all inflammatory gall-stones were found in only 69 per cent. of the specimens in an acute catarrhal condition, in 76 per cent. of the chronic catarrhs, and in 90 per cent. of the advanced chronic cases.

Many cases of infection of the gall bladder recover without the development of calculi. At exploratory operations the viscus is not uncommonly found to be large and flabby slightly thickened, and adherent at many points to the omentum or neighbouring bowel, but without calculi or bacteriological evidence of active infection. The mucous membrane of the gall-bladder possesses great reparative power and even patches of gangrene and ulceration can recover

Pathology of non-calculous cholecystitis.—The causative organism may reach the gall-bladder either directly from the bowel and ducts, or through the blood-stream.

The **different varieties of cholecystitis**, apart from the *special type of causative organism, are really only different stages* of the ordinary processes of inflammation. Thus it may be mild and go on to complete recovery or it may terminate in suppuration with partial destruction of the mucous membrane leading to ulceration and sometimes perforation.

In some cases the whole process is very acute from the first and may lead to early destruction of the wall either in areas or as a whole.

Phlegmonous and gangrenous cholecystitis.—These conditions are associated with peritonitis, either localized or spreading, and may be associated with signs of general septic invasion. When the infection extends to the peritoneum, adhesions may result, a condition that has been clumsily described as pericholecystitis.

Two conditions must be especially mentioned. One is the *straw-*

berry gall-bladder which has been so named from the resemblance of the mucous membrane to that fruit It is the result of a chronic catarrhal inflammation and derives its peculiar appearance from the deposit of lipoids and cholesterin in the mucosa The other is the *papillomatous gall-bladder* in which the mucous membrane is irregularly hypertrophied as the result of chronic inflammation, but without any true new growth. In a series of 5 000 cholecystectomies from the Mayo Clinic, 18 per cent. of the gall bladders were of the strawberry variety and 4 per cent. papillomatous.

The factors which determine the type and course of the disease are complicated, and are not entirely due to the causative organism.

The **naked-eye appearances** of the acute and advanced chronic conditions need no special description. In the intermediate types the surgeon may have difficulty in deciding if the viscus is really the seat of disease. Adhesions limited to the fundus of the gall bladder and without redness or lymph are a sign of previous inflammation. A thick wall, which is of grey colour rather than of the normal greenish or bluish tint, and which shows enlarged lymphatics, is suggestive of a chronic inflammation.

If the contents cannot be squeezed out of the gall bladder there is some abnormality

It is not always possible to determine the pathological condition without opening the gall bladder and this may disclose small calculi or débris which could not be felt from without. Thick, tarry tenacious bile is abnormal The mucous membrane may be typical of the strawberry variety or may be studded with cholesterin.

Clinical features.—The milder cases merely present indistinctive dyspeptic symptoms. In the more severe varieties there may be continuous or paroxysmal local pain and tenderness, with nausea and vomiting, catching of the breath, a very slight tinge of jaundice and rise of temperature to 101 or higher As the local rigidity disappears, the enlarged and tender gall bladder may be felt.

In the most acute cases the onset is very sudden, with rigors, high temperature, and often peritonitic symptoms. Chronic cases so closely simulate chronic cholelithiasis that the same description will serve (see p. 780)

Diagnosis.—Gall-stones and acute appendicitis are the conditions most likely to be confused with cholecystitis. In the former the attacks of colic are more sudden and pass off more abruptly and the temperature is seldom maintained so high as in cholecystitis. Persistent slight tenderness, with frequent exacerbations but without severe pain, is more in favour of cholecystitis than of gall-stones. In appendicitis the pain is lower vomiting is more likely to be prominent, and breathing is not interfered with It may be impossible to

differentiate the very acute cases from acute pancreatitis, intestinal obstruction or pneumonia.

Treatment.—The milder cases may completely recover with rest, limitation of diet, and the exhibition of hexamine, which is excreted in the bile as formalin and acts as an antiseptic. Persistent tenderness with fever, or obvious enlargement of the gall-bladder necessitates surgical interference, which in very severe cases must be prompt. In the latter cases drainage of the gall bladder will probably be the wisest course. Excision of the viscus is never necessary as a life-saving measure, and it may add very much to the risk in the presence of acute inflammation with its greatly increased vascularity

In the chronic cases the surgeon must not be unduly biased by the preoperative diagnosis, and must examine the stomach, duodenum, and appendix before pondering on the significance of some slight change in the gall bladder When this is definitely diseased, cholecystectomy will usually be the best operation but it is not justifiable to add much to the risk, and the rule must be to drain when in doubt.

Cholangitis

Cholangitis is nearly always associated with the presence of gall-stones, and it may persist even after the calculi have been passed. The ducts are full of bile-stained pus, which extends into the smallest radicles. There may be localized dilatations forming abscesses, and these are common on the surface of the liver The walls of the ducts are thickened, the lymphatics are infected, and the accompanying veins are often thrombosed.

Clinical features.—The condition may be preceded by the symptoms of gall-stones, and may follow directly on an attack, or be ushered in by a rigor with uneasiness about the hepatic region, but without severe pain. The patient feels ill and generally looks poisoned, and is more or less drowsy Chills may be repeated irregularly while *the temperature between them is either a little raised or subnormal.* Jaundice is usual but not invariable, and, if well developed, probably depends on some causative obstruction. The liver is enlarged and tender and the spleen may be palpable. The disease is subject to remissions, but is always very serious.

Treatment.—Operation for calculi is unwise during an attack of cholangitis. Free purgation, abundance of fluid by the mouth, infusion of saline, and the exhibition of hexamine in 10-grain doses are the most useful therapeutic measures opium should be studiously avoided. If improvement does not follow the ducts must be drained, directly if the common duct can be easily reached, but usually through the gall bladder When patients are very ill from this condition the drainage is to be looked upon as a life-saving measure, and the removal

of calculi can be left to a second sitting. The special features of the jaundiced cases are dealt with at p 785

TYPHOID INFECTIONS OF THE BILIARY TRACT

Infections frequently occur both in ordinary typhoid and in the varieties of paratyphoid fever

They may result in the various types of inflammation which have been described, or they may be the precursors of gall-stones, or without causing local troubles they may keep up a continuous infection with typhoid bacilli in those who are recognized as "typhoid carriers

Pathology.—In all cases of typhoid the bacilli are regularly present in the gall bladder normally they disappear but sometimes they may give rise to pathological changes in the gall bladder in close relation to the specific fever which they cause, or they may bear an ancestral relationship to conditions such as gall-stones which may not trouble the patient until years after the fever

Groups of cases.—During the attack of typhoid, mild infections of the gall bladder are not uncommon and present the same signs as cholecystitis, but the symptoms are often masked by the features of the fever itself. The inflammation of the gall-bladder may go on to suppuration or to perforation with peritonitis. Suppuration is more common in the paratyphoid group and occurs during convalescence. In other cases cholecystitis due to B typhosus may be found in those who have never presented any symptoms of typhoid fever

In another group are the carriers. These patients may present no symptoms referable to the biliary apparatus, but are suspected by a process of exclusion of other sources (e.g. urinary). When sound medical treatment has failed, surgical intervention is justified. Cholecystectomy combined with drainage of the hepatic duct is required. If the bile from the duct contains the bacilli drainage may have to be continued for a long time and be combined with medicinal and vaccine methods for overcoming the infection.

GALL-STONE DISEASE

Pathology etiology.—Experimental research has proved that though mild inflammation due to attenuated infections is a potent etiological factor a virulent infection is not followed by calculus formation.

When gall-stones cause symptoms, organisms, especially bacilli of the colon group are generally found not only in the bile, but in the calculi themselves. Their presence leads to a mild catarrh of the mucous membrane and therefore to an increased production of cholesterin.

According to Aschoff mere stagnation of bile in the gall bladder without an infective catarrhal process, may lead to the formation of cholesterin stones by simple deposition from the bile. When infection is added, there is an increased production of cholesterin and also of calcium salts which are deposited on the cholesterin nucleus. These, in conjunction with bile-pigment, constitute the pigmented calculi. More than 80 per cent. of stones are such mixed stones, composed of cholesterin, bilirubin calcium, biliverdin calcium and an irreversible colloid such as albumin. Thus the cholesterin precipitation according to this observer is determined by stagnation, the presence of the other constituents implying super added mild infection.



a



b

Fig 523.—Gall-stones showing nuclei. (Actual size.)

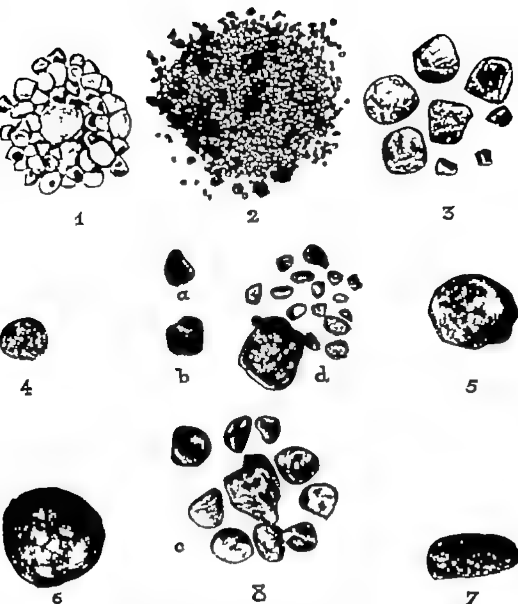
a, Calculus from the common duct. The quadrilateral stone forms the nucleus around which an oval stone has formed, this in turn being covered by amorphous material. b Calculus from the gall-bladder catgut suture forming the nucleus. (From a specimen kindly lent by Hamilton Drummond.)

Though usually formed in the gall-bladder calculi may originate in any of the extrahepatic or even intrahepatic ducts. Some authorities state that very small calculi deposited in the ducts may be washed into the gall bladder by the normal bile current.

The gross forms usually taken by gall-stones are illustrated in Plate 100

As a rule, no nucleus can be found, but without doubt small gall stones often form the centres on which larger ones are built (Fig. 523 a) It is important to recognize that unabsorbable ligatures and sutures may later form the starting points of calculi (Fig 523 b) Inspissated mucus, degenerated epithelium and more rarely masses of bacteria, may constitute a nucleus round which bile-pigments, etc., may be deposited.

Pathological consequences of gall-stones.—Gall-stones are often found post mortem which have exhibited no previous evidence of their existence so far as is known, but it is highly probable that, in these cases, no note has been made of the mild and easily



Varieties of gall-stones. (Actual sizes.)

1 3 Clusters of calculi as ordinarily met with in the gall-bladder

2. The very small type of gall-stone, of which there were 1,654 removed from case of acute distension of the gall-bladder one of the larger stones being impacted in its neck.

4 5. Examples of single calculi from the gall-bladder such as produce ball-valve obstructions.

6. A calculus which was impacted in the ileum, producing acute obstruction.

7 A typical stone from the common duct.

8. A group of calculi from one case (a) from the gall-bladder (b) from the right hepatic duct, (c) from the common duct, (d) from the common hepatic duct.

PLATE 100.

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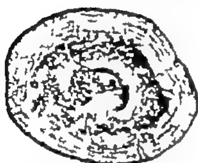


Fig. 523.—Gall-stones, showing nuclei. (Actual size.)

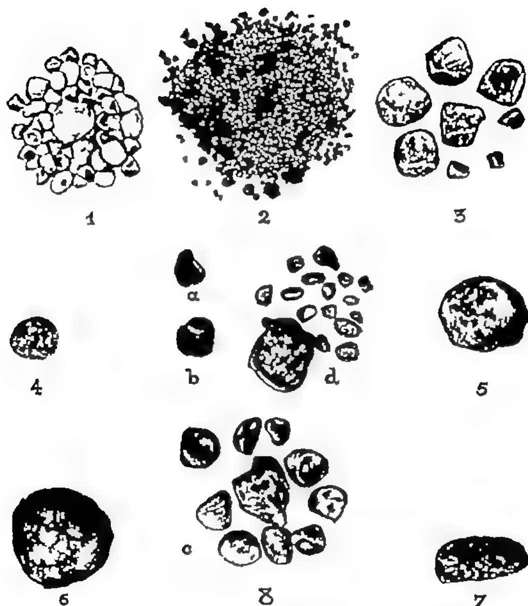
a, Calculus from the common duct. The quadrilateral stone forms the nucleus around which an oval stone has formed, this in turn being covered by amorphous material. b, Calculus from the gall bladder; catgut suture forming the nucleus. (From a specimen kindly lent by Hamilton Drummond.)

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Pathological consequences of gall stones.—Gall-stones are often found post mortem which have exhibited no previous evidence of their existence so far as is known, but it is highly probable that, in these cases no note has been made of the mild and easily



Varieties of gall-stones. (Actual sizes.)

1, 3. Clusters of calculi as ordinarily met with in the gall-bladder.
2. The very small type of gall-stone, of which there were 3,654 removed from a case of acute distension of the gall-bladder, one of the larger stones being impacted in its neck.
4, 5. Examples of single calculi from the gall-bladder such as produce ball-valve obstructions.
6. A calculus which was impacted in the ileum, producing acute obstruction.
7. A typical stone from the common duct.
8. A group of calculi from one case. ( ) from the gall-bladder, (b) from the right hepatic duct, (c) from the common duct, (d) from the common hepatic duct.

PLATE 100.

overlooked symptoms which we now recognize as characteristic of "latent" or quiescent gall stones

As a rule the symptoms associated with gall stones are due to inflammation or to obstruction of the ducts.

Inflammation depends on organisms which may be similar to those associated with the gall stone origin or may be the result of a secondary invasion B coli is most frequently found

In slight cases or very early stages the gall bladder may show very little beyond microscopic changes in its walls though the bile may be turbid or flocculent and later the contents may become purulent forming an "acute empyema of the gall bladder" After a time the mucous membrane is reddened and the whole wall thickened (Fig 524) while still later there may be ulceration or localized gangrene though this usually occurs only when obstruction coexists. Hæmorrhage may take place into such an inflamed gall-bladder When the inflammation becomes chronic the gall bladder is thickened and exhibits fibroid changes while the contents are in most cases purulent, forming "chronic empyema of the gall bladder"

Peritoneal adhesions commonly form and persist, and rarely they may cause trouble

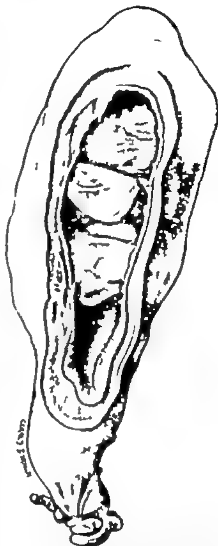


Fig 524 —Acute inflammation of the gall bladder following impaction of a calculus in its neck.

Obstruction is most commonly produced by the impaction of a calculus in the neck of the gall bladder in its pelvis, or in the first compartment of the cystic duct. In the acute cases the consequences depend on the condition of the gall bladder at the time of the impaction. If its contents be infected, the viscus rapidly becomes inflamed and acutely distended, and its peritoneal coat becomes reddened

Fig 535.—Small contracted and functionless gall bladder closely adherent to the duodenum their walls at one point being incorporated suggesting an old perforation

A front; B in section from behind.

and lymph-covered. The mucous membrane ulcerates, and gangrene may supervene (Plate 101) and lead to perforation or to extensive sloughing. An inflamed gall-bladder usually acquires adhesions to the stomach, duodenum (Fig 525) or hepatic flexure of the colon. It may suppurate and burst into one of the adherent viscera or more rarely through the belly wall, leading to the formation of an external biliary fistula. When perforation occurs into one of the hollow viscera calculi as well as pus may thus escape, but not uncommonly the calculus is of the large, single variety and in these circumstances the gall bladder contracts upon and firmly grasps the calculus no further distension occurring as the secreting glands in its wall have been destroyed by the inflammation. Such a calculus tightly grasped by the contracted and functionless gall bladder is apparently safely imprisoned, but it may be potent for evil for as a result of the slow contraction of the gall bladder the stone may be constantly pressed against a neighbouring viscus until it finally erodes into the stomach or intestine. Thus, large calculi, capable of causing intestinal obstruction, may find their way into the bowel. (Plate 100 and Figs 525 526) Moreover the resulting cicatrization and adhesions may produce pyloric obstruction or hour-glass stomach

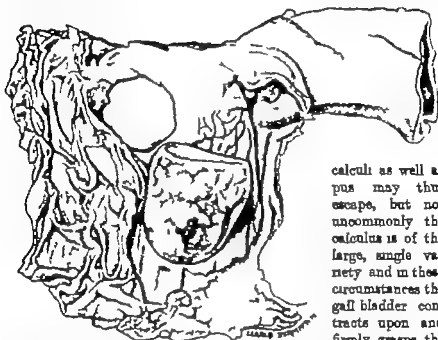


Fig 526.—The first part of the duodenum is laid open, showing a large opening into the gall bladder which is occupied by a faceted calculus. Lying free in the bowel is the sister calculus, which became impacted in the ileum and caused the death of the patient from acute obstruction. The facets on the two calculi exactly correspond.

(*From a specimen in the Museum of the University of Durham College of Medicine.*)

Quite apart from perforation into neighbouring viscera, the gall bladder may drain via the duct and slowly contract down on its contents. Repeated attacks of inflammation cause thickening of the walls, which become hard, white and shiny. Such gall-bladders often harbour early cancer and are best removed. (*See* Fig. 531.) These chronically inflamed gall-bladders may show an hour-glass contraction near the middle.

When the obstruction is gradual, or the contents of the gall bladder are not infected at the time of impaction, "hydrops" of the gall bladder ensues, the viscus undergoing gradual distension with watery or sometimes inspissated jelly like mucus, and its wall becoming thinned without inflammatory changes. (Fig. 527.) Such distended gall bladders may reach an enormous size and have been known to contain as much as five gallons. These are curiosities not likely to be met with at the present day. About four ounces is an average quantity.

These greatly distended gall bladders may give rise to little inconvenience, but they may be ruptured by violence, or may develop cholecystitis due to secondary infection (p. 766). When very large they have been mistaken for ovarian tumours. A hydrops may also result from an acute obstruction with infection, the latter gradually dying down, or lighting up from time to time, but always with lessened virulence. Sometimes relief of obstruction alternates with recurrences and gives rise to an "intermittent hydrops."

Gall stones in the ducts.—Calculi either reach the ducts from the gall bladder after which they probably increase in size (Fig. 523 *a*) or they are formed in the ducts themselves. Commonly they give rise to symptoms of obstruction, and to this infection may be superadded.

Obstruction is due to the size of the stone, the resultant contraction of the duct, and the associated inflammatory changes. It may be temporary and simply lead to slight dilatation of the ducts above which disappears with the passage of the stone into the duodenum. Or the stone may act like a ball valve, falling back into the dilated portion of the duct above, only to be forced down again at some future time. In each successive attack the ducts become more and more distended.

The obstruction is seldom complete for long, and such a calculus may permit free passage of the bile, gaining increment by gradual deposition until it may reach the great size sometimes seen. (Fig. 523, *a*.) But the impaction though rarely absolute, may be practically permanent; then the ducts above become uniformly dilated, to form large channels all through the liver, the common duct itself being sometimes as large as the small intestine.

When a stone is impacted near the lower end of the common duct

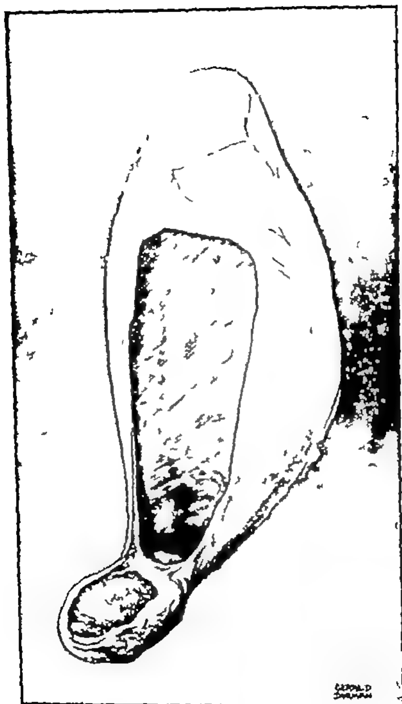


Fig 537 —Chronic distension of the gall bladder (hydrops) from impaction of a calculus in its neck.

it may dilate the orifice and escape into the intestine *per vias naturales*, but more usually it ulcerates through the duct and bowel wall just above the duodenal papilla (Fig 528 *b*)

A calculus in the ampulla of Vater may obstruct the opening and throw the bile and pancreatic ducts into a continuous channel it is then a potent cause of pancreatitis. (Fig 516 p 748)

Remote consequences of gall stones.—Fistulæ may be external or internal; spontaneous or the result of surgical interference; constant or recurring; and biliary or mucoid or muco-purulent.

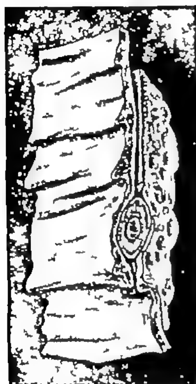




Fig 528.—Diagrams made from actual specimens of calculi in the common duct.

a Calculus impacted in the pancreatic portion of the duct, in position suitable for removal by transduodenal choledochotomy

b Showing how calculus impacted in the same situation has ulcerated into the duodenum, the papilla remaining intact. (*Guy Hospital Museum.*)

External fistulæ, when spontaneous, almost invariably depend on suppuration of the gall-bladder associated with an obstruction in the cystic duct. They usually open just above the umbilicus, but sometimes appear over the normal situation of *the gall bladder* in the iliac fossa, the loin, or even between the lower ribs.

External fistulæ secondary to surgical interference may be mucoid or biliary In the former either an obstruction in the cystic duct has been overlooked, or the gall bladder has been fixed to the skin of the abdominal wall instead of to the peritoneum The latter depend upon some obstruction remaining in the common duct due to calculus stricture or injury of the duct during the operation of cholecystectomy or involvement by pancreatitis or overlooked malignant growth.

Internal fistulæ are probably commoner than external but remain unrecognized owing to their frequent lack of symptoms They usually pass between the gall bladder and the stomach, duodenum or colon but may be between the gall bladder and the kidney the lung, or even the bladder or uterus. These communications are not in themselves the cause of symptoms but the operator must be alive to the possibility of their occurrence so that they may not be overlooked when adhesions between the gall bladder and the viscera are separated.

Stricture of the ducts.—This condition is only common in the *cystic duct*, where it frequently follows the impaction of a calculus. It is best treated by cholecystectomy

In the *common duct* stricture is much more important but fortunately rarer It may follow long impaction of a calculus, and presents the symptoms of obstructive jaundice with or without attacks of pain

Indications for interference in external biliary fistula —This involves the consideration of the probability of natural spontaneous closure of such a fistula. In most cases, after the removal of the drains, the escape of bile should cease in about two weeks after an operation in which the gall bladder or the ducts have been deliberately drained so that if the discharge does not materially lessen in this time or persists after four weeks, then some mechanical cause may be suspected. Secondary operations should however not be undertaken until from eight weeks to three months after the first interference, as in a good many cases the obstruction (for instance, an overlooked stone) spontaneously disappears within this time.

The *treatment depends entirely upon the cause. If the obstruction* is temporary as in some varieties of pancreatitis, the only requirement is to give hexamine, which helps to sterilize the bile and renders secondary infection less likely and to wait for some weeks or months until the inflammatory swelling has subsided

When the fistula is due to the attachment of the gall bladder to the skin, *this must be separated, and the hole in the latter sutured* or the gall bladder removed.

In the cases in which a calculus in the cystic or common duct is the cause this must be removed, when the fistula will probably heal

spontaneously If the gall-bladder has not been removed, and there is difficulty in determining the cause of the obstruction or in dealing with it a short circuit may be made by anastomosing the viscus to the stomach or duodenum.

The worst cases are those which follow cholecystectomy for they usually depend on injury to the common duct. It is then necessary to restore the continuity of the duct, either by (a) direct anastomosis of the two ends, (b) reconstruction of the duct, or (c) anastomosis of the hepatic duct to the duodenum (hepatico-duodenostomy—Mayo)

Intestinal obstruction in connexion with gall-stones may be due to (a) impaction of a calculus in the lumen of the bowel (b) adhesions or deformity associated with an internal biliary fistula (c) involvement of the hepatic flexure of the colon by inflammation spreading from the gall bladder

The stone may escape through a fistulous opening into the first or second part of the duodenum, or more rarely into the transverse colon. One escaping into the colon will probably pass, but one entering the duodenum is likely to cause obstruction if its diameter is greater than one inch. The commonest site for the impaction is in the lower part of the ileum.

Intestinal obstruction due to the impaction of a gall-stone presents some special features. It is largely a mechanical obstruction without the interference with blood supply and nerve supply associated with strangulation therefore vomiting and obstruction predominate, and toxæmia is less obvious than in strangulation.

Most characteristically the patient gives a history such as the following Longstanding, irregular gallstone dyspepsia not usually definite colic (because the stone is of the large, single type and does not get into the ducts) localized pain and tenderness with vomiting while the stone is perforating into the duodenum then a period of comparative comfort or of umbilical pain during the passage of the stone down the intestine, followed by impaction, with return of severe vomiting and intestinal obstruction. Nevertheless in many of the cases the earlier symptoms have been absent or are forgotten, and the patient dates the illness from the onset of the obstruction.

Clinical features of gall stone disease.—Gall-stones are probably three or even four times as common in the female as in the male, and they occur with greater frequency in those women who have borne children. This association is due to the fact that the bile of pregnant women contains four times as much cholesterin as that of other women or of men. On an average they begin to cause trouble at about the age of 35 In many cases they are quiescent for long periods in others they only cause indefinite symptoms, such as "indigestion," or "windy spasms, often erroneously attributed to

other causes; but in about 80 per cent they produce typical attacks of gall-stone colic." It is important to realize that jaundice is only present in a comparatively small proportion of patients whose gall stones are causing symptoms

The **symptoms** that gall-stones may cause are pain, tenderness nausea and vomiting, and jaundice, to which may be superadded the symptoms of infection. The physical signs are those of local peritonitis, with or without enlargement of the gall bladder

The clinical history of gall stone cases can for the most part be divided into three stages—(1) the period when the classical symptoms are absent this is conveniently spoken of as the inaugural stage (2) a stage of typical gall-stone attacks, and (3) a stage of complications, such as infection of the gall bladder and jaundice.

Inaugural symptoms are those which may precede the typical gall-stone colic. As the clinical features of gall-stone disease are better understood, these early symptoms are being recognized as typical and on them alone a correct diagnosis is now frequently made. Distension of the upper abdomen, fullness and tightness with belching of wind is a constant occasion of complaint, commonly attributed to indigestion and spoken of as flatulent dyspepsia Acidity or heartburn is frequent. These symptoms are often accompanied by faintness, and a chilly sensation is frequently noticed, especially in the evenings. There may be slight local tenderness, of which the patient would be unaware were it not for the "catch which occurs on deep inspiration. General seediness and a sallow complexion are frequent

The symptoms met with in the second or classical stage are as follows —

Pain may or may not take the form of an attack of colic." Colic starts abruptly in the epigastrium or right hypochondrium, frequently after a meal and usually during the daytime. The onset may be accompanied by collapse, vomiting, and profuse perspiration. The pain may be agonizing, doubling the patient up or making him extremely restless, but after a time varying from a few minutes to several hours, it passes off, leaving the sufferer exhausted and sore. A sudden onset with an equally sudden termination is characteristic. Other patients suffer from dull aching or sharp pains in the liver region, usually aggravated by food and relieved by vomiting The pain may be referred to the back, shoulder neck, front of chest or down the arm During an attack there may be rigidity of the whole abdomen, especially marked in the upper right quadrant, which is excessively tender The tenderness, at first superficial, later is only elicited by deep pressure, or better by Naunyn's test, which depends on the inability of the patient to take a full inspiration while the examining fingers press deeply beneath the right costal arch. Sometimes tenderness

is found posteriorly two or three finger breadths from the 10th to the 12th dorsal spines, either alone or in association with the tenderness in front

Nausea and vomiting may occur independently of pain. Nausea is often extreme. When vomiting occurs it is at first of greenish, watery fluid, but afterwards no bile is seen, merely watery fluid and mucus.

Jaundice *is found only in about 20 per cent. of all cases*, and even with stones in the common duct only in 33½ per cent. When definite and long continued, it depends on impaction of a stone in the common duct when slight and transient, it may result from catarrh associated with obstruction in the cystic duct In any case this symptom does not appear until the day after the attack but if the block is in the common duct it may afterwards vary from day to day until it either disappears or gradually assumes an olive-green tint. Even with recent and slight jaundice severe bleeding may follow any wound, and in longstanding cases spontaneous hæmorrhage may occur Itching is another very distressing symptom.

Slight **fever** occurs apart from any pronounced infection, and instability of temperature is almost characteristic of gall-stones. A high temperature or repeated rigors suggest severe infection. Stones in the common duct and bile infection, ague-like paroxysms with rigors, and temperature running up to 104° or 105° and as suddenly coming down, make up *the clinical picture of Charcot's "intermittent hepatic fever*

General symptoms such as depression and anorexia, with sour breath and coated tongue, are invariable accompaniments. There may be considerable abdominal distension and severe constipation Sometimes gall-stones are found in the fæces

Local physical signs.—Rigidity of the upper segment of the right rectus and deep tenderness have already been mentioned The presence of a local tumour when discoverable is important. Generally this tumour is the distended gall bladder (Fig 516 p 748) perhaps augmented by surrounding inflammatory complications but sometimes an inflammatory mass around the common duct or rarely even a mass of stones may be felt

A palpable gall bladder appears as a smooth, rounded pear-shaped tumour which moves up and down with respiration cannot be held down, is continuous with the liver above, and can be slightly rocked from side to side. When such a gall-bladder enlarges, it usually does so in a direction downwards and inwards towards the umbilicus, but quite commonly it enlarges directly downwards and may even reach the right iliac fossa. Just after an attack the gall bladder is usually tender and this may persist, but chronic enlargements are neither painful nor tender

The cases as seen by the surgeon may be arranged in the following groups —

1 **Acute cases without jaundice.**—There is sudden onset with severe pain general disturbance and elevation of temperature. At first the right hypochondrium is rigid and tender but at a later stage the enlarged gall bladder may be easily felt The neck of the gall bladder or the cystic duct will be found blocked by a calculus, and the contents of the gall bladder are infected.

2. **Acute cases with jaundice**—The jaundice follows an attack of colic, and there is much general disturbance often with rigors. The right hypochondrium is tender and rigid but at no stage can the gall bladder be felt. A calculus is impacted in the common duct, and the bile is infected

3. **Quiescent (interval) cases without jaundice**—The patient may suffer from vague abdominal discomfort or may be entirely free from symptoms, with merely the history of an attack. The gall-bladder may be felt distended, or there may simply be deep tenderness. There are stones in the gall bladder or common duct or in both.

4. **Quiescent (interval) cases with jaundice**—The patient has the general symptoms of jaundice The gall bladder is not enlarged though the liver may be palpable. There are stones impacted in the common duct.

Diagnosis.—The most valuable diagnostic points are the presence of an enlargement of the gall bladder or localized tenderness over its site. These signs are to be looked for just after the attack has subsided, which is the time above all others when a diagnosis is most likely to be made. If, after an attack of pain in the upper abdomen, the enlarged and tender gall bladder can be felt, or there is definite tenderness over the region of the gall bladder or common duct, the diagnosis of gall-stones is straightforward. In the absence of these signs the diagnosis may have to be made from the history alone. When there is colic the abrupt seizures, the nausea and vomiting, and the shivering are most suggestive In cases without colic, the constant local discomfort with shivering, and the alternation of soreness with periods of complete relief distinguish the trouble from gastric or duodenal ulcer. Severe shivering, constant slight jaundice and wasting suggest lodgment of calculi in the common duct, without impaction, so that most of the bile escapes into the bowel. Chronic jaundice, varying in intensity and free from an olive-green tint associated with attacks of colic, is in favour of gall-stones. The combination of distension of the gall bladder with obstructive jaundice renders the diagnosis of gall-stones improbable (Courvoisier's law). (Fig. 516, p 748, and Plate 103, facing p 812)

Diagnosis by X rays.—Radiographers of very large experience say that from 40 to 60 per cent. of patients with gall-stones will give a positive shadow but since the aid of this method is naturally sought in the cases in which there is the greatest uncertainty the proportion of positive results to be expected is very much smaller. The method is therefore of no negative value, and where the diagnosis is doubtful it cannot be expected to be of much help. Thurstan Holland has pointed out that since the bulk of the lime salts are deposited upon a cholesterin nucleus, the central portion of most gall-stones does not give any shadow while the lime salts show as an opaque ring. He therefore considers the ring-like shadow as diagnostic.

Even when shadows are present in the gall bladder area, great care is necessary in their interpretation, and calcareous glands in the edge of the small omentum have several times led to error. In any event, the detection of gall-stones requires the most perfect apparatus and technique.

The **prognosis** is very uncertain. Gall-stones are always dangerous. Acute obstruction of the ducts may develop in the first attack, and proceed to gangrene, perforation, and peritonitis; or countless attacks of colic may culminate in the passage of all the stones, perhaps after years of suffering; or not infrequently malignant disease or pancreatitis may supervene.

Treatment.—Unless some condition such as diabetes, extreme obesity or cardiac or renal disease, renders operation unduly dangerous, gall-stones should be removed as soon as diagnosed.

Palliative treatment during an attack consists in enjoining absolute starvation. Excessive nausea or vomiting demands gastric evacuation and lavage with an alkali. Pain may be alleviated by hot poultices over the hepatic region, while thirst may be relieved and elimination stimulated by the rectal administration of a pint of half-strength normal saline every four hours. This plan will often obviate the necessity for morphia, with advantage to the rapidity of recovery and the subsequent condition of the patient. Between the attacks, if operation is not to be undertaken, ample exercise, abundant drinks of water and gentle but efficient laxatives, with the daily use of hexamine, should be advised.

Operative treatment. The time to operate.—An interval between attacks should be chosen unless spreading inflammation, sudden perforation and acute peritonitis, or acute pancreatitis demands immediate interference. Even in the presence of localized suppuration some preparation is usually advisable; and long-continued *jaundice* requires a period of probation owing to the danger of hæmorrhage and of toxæmia.

Preliminary treatment.—If time permits, obesity should be reduced by the prohibition of starches, sugars, and fats, combined with free purgation and abdominal massage.

Special preparation of jaundiced patients.—There is grave risk from intra-abdominal hæmorrhagic oozing in these cases, and most of the deaths following operation are due to this cause. No jaundiced patient should be subjected to operation without some

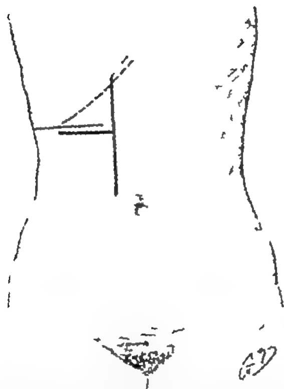


Fig 629.—Incisions used in gall-bladder surgery

The vertical one is that usually employed. In very difficult cases transverse extension through the rectus may be added. The oblique incision is recommended by Kocher, and the strictly transverse one (dotted line) by Rutherford Morison.

preparation Thorough clearance of the alimentary canal and the liberal use of water by mouth and by rectum, with small doses of hexamine should be used as a routine.

When the venous-blood coagulation time is longer than nine minutes, calcium chloride should be given intravenously for three days, 5 c.c of a 10-per-cent. solution being used. During this period the diet should be largely carbohydrate, and glucose should also be

Diagnosis by X rays.—Radiographers of very large experience say that from 40 to 60 per cent. of patients with gall-stones will give a positive shadow but since the aid of this method is naturally sought in the cases in which there is the greatest uncertainty the proportion of positive results to be expected is very much smaller

The method is therefore of no negative value, and where the diagnosis is doubtful it cannot be expected to be of much help. Thurstan Holland has pointed out that since the bulk of the lime salts are deposited upon a cholesterin nucleus, the central portion of most gall-stones does not give any shadow while the lime salts show as an opaque ring. He therefore considers the ring-like shadow as diagnostic.

Even when shadows are present in the gall-bladder area, great care is necessary in their interpretation, and calcareous glands in the edge of the small omentum have several times led to error. In any event, the detection of gall-stones requires the most perfect apparatus and technique.

The **prognosis** is very uncertain. Gall-stones are always dangerous. *Acute obstruction of the ducts may develop in the first* attack, and proceed to gangrene perforation, and peritonitis or countless attacks of colic may culminate in the passage of all the stones, perhaps after years of suffering or not infrequently malignant disease or pancreatitis may supervene.

Treatment.—Unless some condition, such as diabetes, extreme obesity or cardiac or renal disease renders operation unduly dangerous gall-stones should be removed as soon as diagnosed.

Palliative treatment during an attack consists in enjoining absolute starvation. Excessive nausea or vomiting demands gastric evacuation and lavage with an alkali. Pain may be alleviated by hot poultices over the hepatic region while thirst may be relieved and elimination stimulated by the rectal administration of a pint of half-strength normal saline every four hours. This plan will often obviate the necessity for morphia, with advantage to the rapidity of recovery and the subsequent condition of the patient. Between the attacks, if operation is not to be undertaken, ample exercise abundant drinks of water and gentle but efficient laxatives, with the daily use of hexamine should be advised

Operative treatment. The time to operate.—An interval between attacks should be chosen unless spreading inflammation sudden perforation and acute peritonitis, or acute pancreatitis demands immediate interference. Even in the presence of localized suppuration some preparation is usually advisable and long-continued jaundice requires a period of probation owing to the danger of hæmorrhage and of toxæmia.

Preliminary treatment.—If time permits, obesity should be reduced by the prohibition of starches, sugars, and fats, combined with free purgation and abdominal massage.

Special preparation of jaundiced patients. — There is grave risk from intra-abdominal hæmorrhagic oozing in these cases, and most of the deaths following operation are due to this cause. No jaundiced patient should be subjected to operation without some

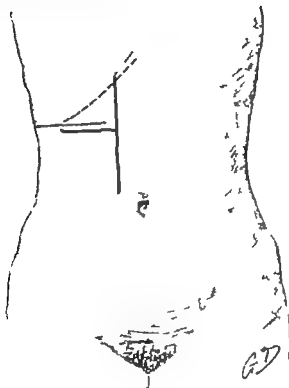


Fig 529 —Incisions used in gall-bladder surgery

The vertical one is that usually employed. In very difficult cases transverse extension through the rectus may be added. The oblique incision is recommended by Kocher, and the strictly transverse one (dotted line) by Rutherford Morison.

preparation. Thorough clearance of the alimentary canal and the liberal use of water by mouth and by rectum with small doses of hexamine should be used as a routine.

When the venous-blood coagulation time is longer than nine minutes, calcium chloride should be given intravenously for three days, 5 c.c of a 10-per-cent. solution being used. During this period the diet should be largely carbohydrate, and glucose should also be

given per rectum. If the coagulation time is not diminished by these means, blood transfusion is indicated 24–48 hours before operation (Mayo). Bleeding may also be prevented and checked by alien serums: fresh horse- or rabbit-serum is best, ox serum being unsuitable. Antidiphtheritic serum is often the readiest to hand, and may be given subcutaneously or intravenously in doses of 10 to 30 c.c.



Fig. 530.—Exposure obtained by Rutherford Morison's transverse incision.

L, Liver; D, duodenum; G.B., gall-bladder; L.O., free edge of lesser omentum. The other viscera are packed away by gauze swabs. The fingers can easily be introduced into the foramen of Winslow for palpation of the common duct.

The operation.—In acute gall-stone conditions, ether by the open method or gas and oxygen, are the only safe anæsthetics, owing to the risk of acidosis after chloroform. The anoci-association method of Crile is particularly useful in these cases.

There is no particular incision which will fulfil the anatomical and pathological conditions of every case. A convenient incision, especially in thin subjects, is a vertical one extending 4 in. downwards from the costal margin, through the right rectus muscle (Fig. 529). Freer access may be gained by carrying the incision upwards and inwards to the costo-xiphisternal notch (Robson), and further room can be obtained by adding a similar extension obliquely outwards below (Bevan). The oblique incision of Kocher gives a very good exposure, and is well suited to obese subjects, but it may inter

fere with the nerve supply of the upper part of the rectus abdominis It runs parallel to the costal margin and extends from the tip of the ensiform across the rectus muscle, and on into the obliques if necessary The strictly transverse incision of Rutherford Morison (Figs. 529 530) is suitable for acute cases in fat subjects, especially when suppuration is expected and it is necessary to drain the hepatic pouch. In all cases, the incision in the skin and subcutaneous tissue must be longer than that in the muscles, and the nerves must never be deliberately divided for if they are gently pulled aside, they can often be spared even in a long and difficult operation.

The deeper ducts can be brought nearer the surface by placing a long, narrow sand bag or pneumatic bolster transversely beneath the lower thoracic region. The same object may be attained by a mechanical bridge attached to the table or by wooden wedges passed from either side. (The operator must remember to lower the patient at the end of the operation, before attempting to suture the wound.) By drawing on the gall bladder lifting forward the liver and rotating it on its transverse axis, the surgeon can straighten out the ducts and approximate the deeper parts still nearer to the surface. Before dealing with the gall bladder careful examination must be made of the whole biliary apparatus, and of the liver pylorus, duodenum pancreatic head, hepatic flexure, and sometimes of the appendix. The ducts are palpated by passing the fingers along the right side of the gall bladder over its neck, down the cystic duct, and through the foramen of Winslow Here the common duct can be felt between the fingers behind and the thumb in front of the gastro-hepatic omentum. The lowest part of the duct must be palpated through the duodenal wall. Finally the hepatic ducts are to be explored right up to the liver It must be remembered that sometimes, in a very tense gall bladder small calculi cannot be felt also that enlarged glands near the neck of the gall-bladder and at the junction of the cystic and common ducts may be mistaken for calculi. After the gall bladder and its contents have been dealt with another examination of the ducts is necessary to ensure that no calculi have been overlooked.

The subsequent steps depend on the conditions found. *If calculi are found only in the gall-bladder are free, and not associated with inflammatory signs* the ideal treatment is to perform cholecystectomy but if for any reason the operator is doubtful as to the wisdom of this step the calculi should be removed, and the gall bladder should then be drained (cholecystostomy) The surgeon must satisfy himself that all the stones have been removed by exploring the interior of the viscus with the finger. Cholecystendesis, by which the opening in the viscus is sutured and the abdomen closed, perhaps with a small drain down to the sutured gall bladder is generally inadvisable, for

it makes no provision for the escape of a possibly overlooked tiny stone or for drainage of the infected biliary canal. This is, however a good operation for the incidental removal of gall-stones—i.e. when they are discovered in the course of an operation carried out for some other purpose.

In *cholecystostomy* a drainage-tube is fastened into the open gall-bladder by an invaginating sero-muscular purse-string suture of No. 1 chromicized catgut, placed ¼ in. from the cut edge. In simple cases, with free flow of bile, the tube may be removed in from seven to ten days.

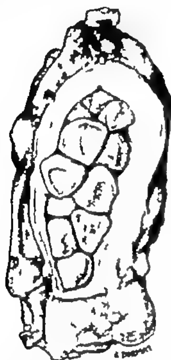


Fig 531 —Chronically in flamed and thickened gall-bladder with cal culi. Such a gall bladder is often the seat of early malignant disease.

If calculi are impacted in the neck of the gall-bladder or in the cystic duct with or without suppuration or gangrene either the gall-bladder must be removed or an attempt must be made to dislodge the stones back into the viscus with the fingers working from outside The gall bladder must then be opened, its contents removed and the interior carefully dried with a strand of gauze. If bile at once flows, the duct is free, but in inflammatory conditions the thickening may delay the appearance of bile for some days.

If the obstructing calculus cannot be removed by manipulation, an incision may be made directly over it (cystic otomy) or the gall bladder may be removed. In cases of great urgency the gall bladder may simply be drained, and if the calculus does not loosen and come away spontaneously it may be removed at a second operation or a secondary cholecystectomy may have to be performed

When inflamed and suppurating the gall-bladder and its surroundings are very vascular and its removal may be attended by troublesome hæmorrhage. In these circumstances excision is much more dangerous than simple drainage.

The same remarks apply to gangrene of the gall-bladder This is rarely total, and nearly always first reaches the peritoneal surface at the fundus (Plate 101) In most cases drainage is safest and best in a few the fundus only may be excised and, even for total gangrene, ample drainage and isolation by gauze packing is probably the



Acute cholecystitis, the result of calculous obstruction of the cystic duct. There was extensive gangrene of the mucous membrane, which had extended to the peritoneum at the fundus. (Actual size.)

PLATE 101

wisest course for in these cases the shortest possible operation with little loss of blood is essential

If the gall-bladder is firmly adherent to surrounding structures as the result of chronic inflammation it may be impossible even to see the viscus until the adhesions are separated To avoid peritonitis or fistula, great care is necessary in separating the stomach duodenum or colon for where the gall bladder has leaked into these viscera communications frequently exist After exposure these densely adherent gall bladders are often found to be quite small and closely contracted on a mass of stones They are frequently very thick walled and often white and shiny (Fig 531) Such gall bladders



Fig. 532.—Diagram to show how the common duct may be injured during cholecystectomy (*After Kehr modified.*)

should be removed for a certain proportion of them turn out to be the seat of malignant disease.

Sometimes the greater part of the gall bladder has been destroyed only the neck and cystic duct remaining After removal of the calculus, a tube must be led out from the duct and the cavity walled off by gutta percha tissue or gauze The omentum is useful as a covering for the involved area.

Cholecystectomy—The removal of a moderate-sized gall-bladder if the region of the cystic duct is free, may be commenced by catching and dividing the cystic artery and duct, and then separating the gall-bladder from the liver from below upwards. A very large

viscus must sometimes first be emptied to secure a view of the region of the neck When the gall bladder is shrivelled or when the parts about its neck are obscured (Fig 525 p. 774) then it is best to separate the organ from the liver as a first step, and to use it as a tractor while the cystic duct and artery are carefully exposed.

As a rule, the gall bladder is not removed when drainage of the



Fig 533.—Accidental removal of a portion of the common bile-duct.

Cholecystectomy was performed for chronic infection associated with calculi. The cystic duct was very much shortened and in consequence the portion of common duct through which the glass rod has been passed was inadvertently excised.

ducts is necessary but if thought desirable a tube may be brought out from the end of the duct In any case it is wise to insert a small tube down to the region of the divided and ligatured cystic duct. The raw area on the liver may sometimes be covered with peritoneum reflected from the sides of the gall bladder but any oozing from it must be treated by gauze packing

In many cases serious injury to the common or hepatic duct has been inflicted during the performance of cholecystectomy (Fig. 532)

Fig. 533 is from a case in which a complete section of the common duct was inadvertently excised. As previously mentioned, stricture or obliteration of the duct may follow and may be the cause of a permanent biliary fistula or chronic jaundice.

The only way to avoid these accidents is for the operator clearly to see the junction of the cystic with the hepatic and common duct before the gall bladder is cut away. In some few cases, anatomical anomalies or pathological changes about the neck of the gall-bladder may render its removal inadvisable. The surgeon must then abandon the attempt and perform cholecystotomy.

If calculi are present in both gall-bladder and common duct the latter should be opened first, the intact gall-bladder being a useful tractor. The calculi may be free in the duct or impacted in the lower end. Whenever possible, they should be manipulated into the supraduodenal portion of the duct which can be safely opened and the stones removed. Direct drainage of the common duct is usually advisable. The gall bladder is now either excised or the stones are removed and the viscus closed if healthy or separately drained.

Calculi impacted in the lower end of the common duct may rarely be pushed on into the duodenum, or pushed back into the duct above, but as a rule, the duct must either be opened behind the duodenum or by the transduodenal route (Fig. 523, *a* p. 778). When calculi are also present in the hepatic ducts they may be coaxed down into the common duct, or removed by direct incision, or broken up and extracted in fragments.

If any doubt exist as to the complete removal of the calculi not only must ample external drainage be provided, but a good-sized metal probe (Lister's bougie, $\frac{8}{11}$) must be passed from the duct into the duodenum, so dilating the papilla that any overlooked fragments may pass.

When well-marked jaundice is present at the time of the operation, the common duct should always be opened and explored but when there is merely a history of passing attacks of jaundice, then it is not necessary to open the duct unless calculi can actually be *felt* in it. Especial gentleness must be exercised in operating on jaundiced patients, as every additional trauma adds to the risk of postoperative hæmorrhage.

After-treatment.—If vomiting be troublesome a pint of hot water should be drunk, and if this fail, the stomach should be washed out. Even in the absence of vomiting, eructation of mouthfuls, or hiccup with fullness and epigastric distress, demands gastric lavage, repeated if necessary for these symptoms may be premonitory of acute dilatation of the stomach, which is a very grave complication.

The rectal injection of warm water should be used in all but the simplest cases, for it combats any tendency to shock, relieves thirst and most important of all, greatly aids elimination.

Drainage-tubes should be removed about the tenth day and as a rule the discharge of bile will stop by the fourteenth day

Jaundice only slowly disappears, and hæmorrhage may come on as long as a week after operation. Precautionary measures must therefore be taken when recovery is slow Impaction of fæces is common during convalescence if there has been jaundice.

Results of operations.—*The removal of gall-stones that* have not left the gall bladder or set up dangerous complications should not cause a mortality of more than 2 per cent., and taking all gall-stone operations together the death rate should not be more than 5 per cent. Jaundice from impaction of calculi in the common duct increases the mortality at least threefold.

The percentage of recurrences in simple cases is small (not more than 2 or 3 per cent.) but it rises *pari passu* with increasing complications. Cholecystostomy has been attended by a larger proportion of recurrences, but this operation has often to be used when there is infection of the deeper ducts, or some other complication which would add greatly to the risk of cholecystectomy. It is important to recognise that recurrence is possible after complete removal of the gall-bladder Overlooked malignant disease, hepatitis, or progressive pancreatitis may lead to disappointing results after otherwise successful operations.

NEW GROWTHS

Simple growths of the gall bladder and ducts are very rare; fibromas, lipomas, and cystic adenomas have been met with; papillomas are the most frequent, but here apparently they are not so closely associated with cancer as elsewhere. This is probably due to the fact that in most of the reported cases the papillomatous condition was the result of gross inflammation and not a true new growth.

Carcinoma of the Gall-Bladder

Etiology—In over 80 per cent. of cases of cancer gall-stones are associated. Cancer is commoner in women than in men in the same sex *proportion as calculi. The average age is just over 50,* the disease being uncommon before 40 years.

Morbid anatomy.—The disease is met with in three forms (1) As a definite localized tumour usually at the fundus, though sometimes in the body producing an hour-glass constriction, or at the neck, causing obstruction (Fig 534) (2) as a diffuse thickening of the whole wall of the gall-bladder which is white, glistening, and tightly contracted on a mass of calculi (Fig 531) (3) rarely as a fun-

gating growth filling the gall bladder and perhaps causing hæmorrhage (Fig. 535) Sarcoma also occurs but is extremely rare.

Microscopically the growth is usually columnar or spheroidal celled It tends to spread down the ducts and to involve the liver



Fig 534 —Primary carcinoma of the gall-bladder producing hour-glass deformity and involving the liver by direct extension. (*Actual size.*) Case of successful excision by Rutherford Morison.

by direct extension later it may extend to the colon, duodenum or peritoneum.

Clinical features.—The early history is usually that of cholelithiasis, gradually followed by long-continued ill health, with constant hepatic pain and progressive emaciation, disproportionate to

gall-stone disease. Jaundice appears late in about half the cases. Persistent local pain is the most characteristic feature.

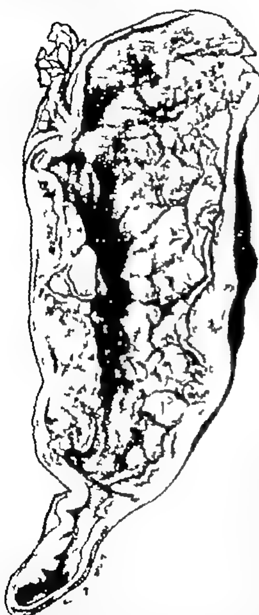


Fig 533.—Carcinoma of the gall-bladder of the fungating type The viscus was greatly distended with blood. (*Actual size*)

Physical signs may be entirely absent, or there may be a hard, nodular tumour in the gall-bladder region.

Diagnosis.—Gall-stones, especially with inflammatory complications, malignant disease of the liver carcinoma of the stomach adherent to the liver or a growth in the hepatic flexure most commonly lead to confusion. The history and symptoms rather than the physical signs are likely to aid in differentiation.

Prognosis.—Death usually occurs within six months.

Operative treatment.—Unless the presence of unequivocal secondary deposits renders operation useless, exploration should always be made, for inflammatory masses may closely simulate cancer The diagnosis confirmed, and the possibility of complete removal ascertained the surgeon should *freely excise the gall-bladder* with a wedge of healthy liver tissue.

Direct extension *to the* liver does not necessarily preclude successful operation, but careful examination is required to determine the absence of associated secondary deposits in that organ. If complete excision be impossible, operation should be abandoned, for the mere removal of calculi never does good

and there is great risk of the growth fungating into the parietal incision or of a persistent mucous or biliary fistula Even in apparently favourable cases early recurrence in the liver or peritoneum is very frequent. Cases in which a chronically inflamed gall bladder is found microscopically to harbour cancer present better results.

Carcinoma of the Bile Ducts

Primary malignant disease of the bile-ducts occurs more frequently than is supposed The disease differs from cancer of the gall bladder in that it is usually not associated with gall stones, and that males are more commonly affected than females, though it occurs at the same period of life.

Pathology.—The growth may affect any duct, but usually attacks one or other end of the common duct. It forms a columnar celled carcinomatous ring and appears as a stony hard, white nodule, not larger than a cherry easily mistaken for a calculus. Obstruction is absolute, the ducts above are dilated and the liver bile-logged.

Clinical features.—Jaundice commences insidiously and gradually deepens without intermissions until the skin may assume a dark bronzed or olive-green tinge. Pain is inconstant there may be an attack of colic, but this is seldom repeated. There are no physical signs beyond enlargement of the liver and of the gall bladder when the common duct is involved.

The **diagnosis** is suggested by painless, persistent, and otherwise unexplained jaundice in a patient between 50 and 60. Gall-stone obstruction is nearly always attended by a history of repeated attacks of pain and sudden onset cancer of the pancreatic head may be palpable, or may be indistinguishable while catarrhal jaundice so surely clears up as to render diagnosis certain.

Prognosis.—Death inevitably occurs from cholæmia, hæmorrhage, or infection, in from six months to a year from the onset.

Treatment.—It may be possible to excise the growth, either with end to-end union, implantation into the duodenum, or ligature of both ends and cholecystenterostomy Generally however cholecystenterostomy without excision will be the only available measure. This may enhance the patient's comfort by relieving pruritus and it ensures against a possible mistake in diagnosis.

Cholecystenterostomy.—The ideal method is to unite the fundus of the gall bladder to the duodenum but the latter may not be available on account of fixity or adhesions. In these circumstances the union may safely be made to the nearest portion of the stomach (cholecysto-gastrostomy) or colon. In any case the opening should not be less than one inch in diameter and union should be made with two layers of continuous catgut suture

The greater part of the inner wall of the duodenum is so intimately associated with the pancreas that ulcerative conditions arising in this part of the bowel readily extend into the substance of the gland. Similarly ulcers of the posterior wall of the stomach or even of the lesser curve are prone to reach the pancreas and to erode it in spite of the intervening peritoneum. The tail of the pancreas may readily be included in the ligature used in the operation for removal of the spleen.

The *pancreas is a compound acino-tubular gland, resembling the parotid,* but more loosely arranged and possessing interacinous islands of small polygonal cells known as the islands of Langerhans.

Abnormalities.—The head of the pancreas may completely surround the duodenum. An accessory pancreas, varying in size from a hempseed to a bean, may lie in the wall of the stomach, duodenum, jejunum, or ileum, and has been found at the apex of a gastric or intestinal diverticulum. Rarely the pancreas is abnormally movable and has been found in both diaphragmatic and umbilical hernias.

INJURIES

Though more rarely injured than the other viscera, the pancreas suffers slight traumatisms not infrequently. The injury may be penetrating, or much oftener, subcutaneous, and, though commonly confined to the viscus, may be associated with lesions elsewhere. There may result extensive and perhaps fatal hæmorrhage, or escape of juice with retroperitoneal inflammation, or acute pancreatitis due to bruising. In slighter injuries the peritoneum covering the pancreas is often torn, and blood and pancreatic juice escape into the lesser sac, leading to the development of an inflammatory effusion or pseudo-cyst (see p. 807) and the production of fat necrosis. *Gun-shot and stab wounds* are very serious and are usually associated with other injuries. The latter are often the more apparent, and unless the wound of the pancreas is suspected and carefully searched for it may easily be overlooked, with very serious consequences.

Clinical features.—The symptoms vary with the severity of the trauma. In some cases there is profound shock or hæmorrhage without localizing signs other than the site of the injury. In others, shock is less severe, and is accompanied by pain, vomiting, tenderness and rigidity of the upper abdomen, and the rapid accumulation of free fluid; in such a case, subsidence of symptoms and resolution may occur or the development of local peritonitis or of pancreatitis may be indicated by increasing symptoms and a rising temperature and pulse-rate. Permanent recovery may ensue or temporary amelioration be followed by signs of an inflammatory effusion into the lesser sac from ten days to three or four weeks after the accident. Glycosuria rarely occurs, but when present is of valuable diagnostic significance. In another type of case injury to the head of the gland may be followed by inflammatory swelling and temporary obstruction of the bile-duct, leading to jaundice.

Treatment must at first be expectant, unless there are evidences of severe internal hæmorrhage. If the symptoms steadily become accentuated, while the tenderness and rigidity persist or a mass develops, operative interference is necessary. The pancreas can best be exposed by tearing through either the gastro-hepatic omentum or the gastro-colic omentum. The object of the operation is (1) to stop hæmorrhage, (2) to prevent leakage, and (3) to provide drainage.

If the pancreas is found torn, it may be possible to tie bleeding vessels,

and then to suture the laceration—in this way a pancreas completely torn in two has been repaired. Bleeding having been stanched and any associated injury treated, all clots must be removed and the lesser sac thoroughly mopped out. A large rubber tube must be inserted and packed round with gauze to control hæmorrhage and to soak up escaping secretion.

In dealing with penetrating wounds, associated injuries, especially of the stomach, must be carefully sought. In some few cases, fluid with the characteristics of pancreatic juice has been removed from the chest in convalescence.

Excision of a portion of the gland is not infrequently required in the operation of gastrectomy. The wound so made should be closed by catgut sutures, and a track to the surface should be provided by a rubber drain. Gauze must not be left in contact with the pancreas, unless for the purpose of stanching otherwise uncontrollable oozing.

PANCREATITIS

Inflammation of the pancreas may come before the surgeon in three ways—(*a*) as an acute abdominal emergency (*b*) as an unsuspected accompaniment of gall-stones (*c*) as a chronic disease. In any circumstances it is a serious condition.

Etiology.—Experimental injection of a variety of substances into the duct of Wirsung produces acute inflammation with hæmorrhages, and glycosuria, and, later abscesses or chronic inflammation. In man, gall-stones frequently coexist with pancreatitis. When not found, it may be that the stone has passed into the intestine after setting up the inflammation.

In some cases it has been suggested that the obstruction is due to spasm of the sphincter of Oddi which in turn may be produced by hyperacidity of the duodenal contents When endeavouring to correlate these facts, Opie found that in 62 per cent. of subjects the termination of the bile-duct was so arranged that a small stone lodged there would dilate the ampulla and permit retrojection of bile into the pancreatic duct this retrojected bile may have the same effect in producing pancreatitis as the various substances used experimentally. It has also been suggested that bile thus retrojected activates the latent pancreatic secretion and leads to auto-digestion of the gland and consequent acute inflammatory manifestations. Binet and Brocq as the result of experimental work conclude that this activation of the proferments of the pancreas can be brought about by a kinase produced from the pancreatic cells, from the blood, or as the result of bacterial activity as well as by the bile or duodenal contents.

There can be no doubt about a blood infection in some cases, as, for instance in mumps and in certain of the chronic inflammations which occur

As the same agents may cause acute or chronic pancreatitis, some explanation of the incidence of the two classes must be sought. Flexner concludes that the sudden retrojection of fresh, unaltered bile

Morbid anatomy.—The slighter changes in the pancreas are not visible to the naked eye. This is especially true of the changes following catarrhal inflammation of the ducts and of those in chronic pancreatitis.

In **acute pancreatitis** the pancreas may be embedded in blood or may be but a little larger and, in the early stages firmer than normal. There may also be areas of softening of the pancreatic substance with definite evidence of gross infection. Later necrosis of considerable areas of the gland is obvious, and may involve either scattered patches or more commonly an extensive portion of the body but the head and extreme end of the tail are often spared. In very acute cases the pancreas may become a disintegrating mass associated with retroperitoneal cellulitis, but, when time permits, the parts around form the walls of an abscess cavity in which a large slough may lie completely separated from the rest of the gland (Plate 103). Such an abscess may burst into one of the hollow viscera, or even externally and in this way part of the pancreas may be discharged, and the patient recover.

In all cases peritonitis is considerable, most pronounced about the pancreas, and sometimes localized in the lesser sac (inflammatory effusion into the lesser sac). The effusion may be serous, hæmorrhagic, or deeply bile-stained.

In **chronic inflammation** few changes may be apparent to the naked eye. Sometimes the whole gland is a little enlarged and uniformly hard, looking like a "waxen cast" or again, the head only may be enlarged, irregular and knobby like a malignant tumour. It is not justifiable to make a diagnosis of chronic pancreatitis on the unsupported evidence of some slight increased hardness of the gland as felt at an operation, for the consistence of the normal pancreas varies within wide limits.

Microscopically there are two forms of chronic pancreatitis—(1) the interstitial interlobular variety in which the normal connective tissue is converted into a dense fibrous stroma compressing and gradually replacing the gland, and (2) the interacinous variety in which the fibrous tissue separates the glandular acini and even sometimes the separate cells. In this form the cell islands are soon involved and diabetes often supervenes.

Clinical features. **Catarrhal pancreatitis.** — Catarrhal inflammation probably often precedes the more acute processes and may arise after influenza, or as a complication or sequel of mumps, and probably is the active feature in many cases of so-called catarrhal jaundice.

Suppurative catarrh of the ducts resembles suppurative cholangitis, with which it is usually associated. It may also occur with pancreatic

calculi. The treatment is external drainage via the common bile-duct and the gall-bladder

Acute pancreatitis usually occurs about middle life, the period of election being between 35 and 50 though it has occurred in a child of only 5 and in a man of 75 Statistics show that males are affected *nearly twice as often as females. Although the disease may attack* healthy patients, there is frequently a history of antecedent dyspepsia and of seizures of pain in the upper abdomen, and in about 25 per cent. of the cases the victims are stout people of alcoholic habits.

The onset is usually sudden, and very acute, with epigastric pain so severe and collapse so profound that perforation of the stomach is closely simulated. Epigastric tenderness and muscular rigidity in the supra umbilical zone are associated with violent belching and vomiting. The pulse is small and thready and cyanosis may be pronounced. Such cases may end *fatally* within twenty four hours.

In those that survive the early collapse, inflammatory symptoms supervene usually the pulse now becomes accelerated, but it may remain slow

Constipation is generally obstinate, but there may be diarrhœa and even melæna. Albuminuria is common glycosuria is rare, but, if found, helps to confirm the diagnosis. Slight jaundice occurs in about one-fifth of the cases. There is often much pain in the back.

Locally there are at first great tenderness and rigidity in the upper abdomen, and in from twelve to twenty four hours an indefinite mass may be felt in the epigastrium or sometimes in the left lumbar region. Later still the signs of epigastric or diffuse peritonitis with fluid or of retroperitoneal cellulitis may be superadded or evidence of inflammatory effusion into the lesser sac may indicate a tendency to localization and subsequent recovery Local discoloration of the abdominal wall is sometimes present. It appears characteristically in the flanks (Fig. 537) but has also been noted around the umbilicus. The area affected is about the size of the palm of the hand, and is of a dirty greenish-yellow colour very like the appearance of the skin in a late case of extravasation of urine or early post-mortem staining as seen on the abdominal wall. The area is slightly œdematous and the œdema fades away into the surrounding tissues. This sign occurs only in the very acute cases, and appears during the first week It is due to the direct escape of pancreatic secretion, and is of very grave significance.

In some cases, after an acute onset the symptoms may apparently disappear for a time, but the pulse-rate remains fast, and a mass gradually develops in the pancreatic region this is followed by localized suppuration or sloughing of the gland (Plate 102) In others, ultimate recovery after a prolonged illness may follow rupture of an abscess

into the bowel or temporary improvement may end in late death (four to six weeks after operation) from pancreatic insufficiency. In cases of another class, often spoken of as subacute pancreatitis, changes are seen similar to those of acute pancreatitis, but of a milder character. This form may only be revealed during operations for cholelithiasis, and, though recovery often results after removal of the calculi and drainage is of grave prognosis.

Hæmorrhage from neighbouring vessels is especially liable to occur in acute pancreatitis, and was the cause of death in one case on the seventy fourth day following the operation.

Diagnosis of acute pancreatitis.—Most of the cases have been mistaken for acute intestinal obstruction, visceral perforation or gall-stones. The most important features are the agonizing pain,

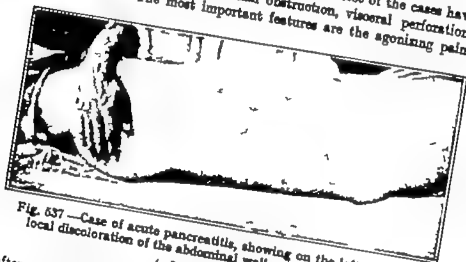


Fig. 637.—Case of acute pancreatitis, showing on the left flank the local discoloration of the abdominal wall referred to in the text. (*Brit. Journ. of Surg.*)

often unrelieved by morphia, the tendency to cyanosis with air hunger and the very marked epigastric tenderness, soon followed by the development of a mass. These symptoms, with evidence of epigastric peritonitis and a subsequent inflammatory swelling posteriorly, particularly if in the left lumbar region (Körte) are suggestive of acute pancreatitis. The discovery of fat necrosis on opening the abdomen is strongly confirmatory. The Cammidge test is unreliable especially in the early stages of acute pancreatitis. The urinary diastase and adrenalin mydriasis tests may be helpful because they can be carried out within an hour (Garrod). A diagnosis of gall-stone disease is often correct, but a more serious pancreatitis may accompany it.

The **prognosis in acute pancreatitis** is always very grave, the mortality being probably 75 per cent.

Treatment of acute pancreatitis.—Whenever acute pancreatitis is suspected, an operation is demanded (1) to remove the

cause, which will usually mean removal of gall-stones and always drainage of the bile-passages (2) to relieve tension about the pancreas by incising its peritoneal covering (3) to remove fluid from the peritoneum and (4) to provide drainage. Körte however holds that under no consideration should the gall bladder be incised and drained at the primary operation while the patient is collapsed.

The gland is best exposed by a free median incision but if there is much effusion in the flanks, and especially retroperitoneally either a transverse incision should be made or separate incisions from the loin. Probably most benefit follows free external bile drainage, and many cases are cured by this alone. The pancreas should be exposed by tearing through the small omentum, and then through the overlying peritoneum. Any accumulation of fluid in the lesser sac will thus be evacuated and an escape provided for retroperitoneal extravasation. Incision of the substance of the pancreas itself is of doubtful value; if it be done, a dissector should be employed for the purpose, owing to the risk of severe hæmorrhage. If the general peritoneal cavity contains much fluid, it should be emptied and drained. When there is a definite localized mass the surgeon may find a considerable retroperitoneal collection, which may be drained from the front. When the case is of longer duration and the symptoms indicate sloughing of a considerable part of the gland, the sloughs must be sought and removed. Holes into the bowel for natural evacuation must not be overlooked.

During convalescence the surgeon must be on the watch for signs of pancreatic insufficiency. Continued slight vomiting is always a very suggestive symptom, and, later wasting, air hunger and cyanosis are pathognomonic.

To anticipate and correct this condition, care must be taken with feeding and the secretion of the gland must be stimulated by the exhibition of weak acids, while an attempt must be made to supply the deficient ferments. Great benefit often follows when some reliable pancreatic extract is given either by the mouth or per rectum, but it may have to be continued for many months.

Relapses after operations for acute pancreatitis.—The majority of cases that survive operations for acute pancreatitis appear to be completely cured though a proportion develop chronic pancreatitis or diabetes, so that the prognosis after operation must be guarded. Recurring attacks of pain are probably due to overlooked gall-stones or to concomitant duodenal ulcer. Sometimes a cyst develops as a late result, or slight recurrence may follow insufficiently prolonged drainage.

Chronic pancreatitis.—This group includes all cases that come on gradually and that are attended by an increase of fibrous

tissue. The etiology pathology and morbid anatomy have been already described. The disease is rarely primary but once initiated it tends to increase progressively and to end in death. In the early stages the clinical symptoms may be very few and yet there may be important changes in the functions of the gland, which can only be detected by an examination of the fæces and urine.

The laboratory signs of pancreatic inadequacy can be summarized as follows —

1 *Defective external secretion.*—(a) Failure of tryptic digestion. Unaltered muscle nuclei present in fæces (azotorrhœa) (b) Failure of starch digestion. (c) Failure of fat digestion, as shown by fatty stools (steatorrhœa) or fat droplets, fatty acid crystals, or soap detected by the microscope.

2. *Defective internal secretion.*—(a) Glycosuria. (b) Diminished sugar tolerance, to be regarded as a late symptom. (c) Adrenalin eye test (pupil dilates on adding adrenalin)

3. *Signs of pancreatic disintegration.*—(a) Increase in urinary diastase. (b) Cammidge's pancreatic reaction. This test is now generally regarded as of very little value. We may say that if the adrenalin eye test and the diastase test are negative, it is seldom worth while to undertake more elaborate investigations. If there are fairly fatty stools without jaundice, and the excess of fat is in the unsaponified form, it is very suggestive of pancreatic disease. If there are also muscle nuclei in the stools, it strengthens the diagnosis. If all these symptoms are present in addition to glycosuria, the diagnosis is certain" (Langdon Brown)

The symptoms of pancreatic insufficiency are uncontrollable slight vomiting, wasting, lowered blood-pressure and general circulatory failure as shown by peripheral cyanosis with lowered temperature. The patient bears an anxious expression is listless, sickly and shrivelled and remains blue and cold in spite of all measures to induce reaction and warmth.

Clinical features of chronic pancreatitis.—The cases vary very much in their onset, and may usually be divided into the following groups —

1 Those in which attacks of pain are the main feature.
2. Those in which the first definite symptom is jaundice.
3. Those with general failure of health and possibly glycosuria.
4 Cases accidentally discovered at operation, in which the symptoms of gall-stones have masked those of the pancreatitis.

In the first group the condition probably begins as a subacute infection, which quiets down as it becomes chronic. The attacks of pain may be due to little outbursts of inflammation or to the gall stones, the original cause. In these cases there are often attacks of

shivering, and in the later stage there are apt to be the general symptoms mentioned in the third group

The second group includes the cases in which the condition is most commonly mistaken for cancer Jaundice may gradually deepen without intermission, and the patient rapidly waste. If in these circumstances, the gall-bladder is distended, cancer is closely simulated.

In the third group there is extreme weakness and emaciation, with loss of appetite and loathing of food. The skin assumes an earthy hue there are alterations in the urine and fæces, and there may be diabetes.

Many cases, undoubtedly fall into the fourth group, and are discovered during operations. But the surgeon must not be led into diagnosing chronic pancreatitis from undue hardness of the gland without the confirmatory evidence afforded by an examination of the fæces and urine.

Physical signs.—In any of these groups an enlargement of the pancreas may be felt, the gland being swollen and tender The enlarged gland may show in a radiogram. The enlargement varies from time to time, and may vanish and reappear There may be no tumour but tenderness in the epigastrium or just above and to the right of the umbilicus. In cases with jaundice the gall bladder is felt to be distended.

Prognosis.—Chronic pancreatitis is rarely a direct cause of death, but often leads to fatal diabetes.

Treatment.—Many cases are greatly improved by medical means, and especially so if some probable cause can be treated. The presence of a definite mass with or without jaundice indicates the necessity for operation. Such a mass may be malignant or inflammatory If the latter it may disappear after mere exploration, after drainage of a retroperitoneal collection, or after cholecystenterostomy This latter operation is desirable if possible, and may even sometimes prove of benefit in malignant disease. If a satisfactory anastomosis be found very difficult, external drainage should be substituted. When painless jaundice is the only symptom, operation should be deferred for at least six weeks to give time for spontaneous clearance, lest the jaundice be only catarrhal. If there are merely attacks of pain confidently attributable to pancreatic involvement, operation is necessary for the attacks may proceed from gall-stones or pancreatic calculi. If there is no removable gross lesion, it is a moot point whether anything further than simple laparotomy can be of service, though some recommend routine cholecystenterostomy

When a general failure of health or glycosuria can be traced to pancreatic involvement, without an acute onset or without any enlargement of the organ, surgical intervention is to be avoided

SYPHILIS AND TUBERCULOSIS

Syphilis rarely affects the pancreas. It may take the form of an indurative pancreatitis or of a gumma. Isolated gummata have been recorded sufficiently often to justify administration of iodide and mercury in any case of irremovable pancreatic tumour without unequivocal signs of cancer.

Tuberculosis is equally rare, but may occur in the miliary form or as an isolated tuberculoma.

PANCREATIC CYSTS

Classification.—Cysts of the pancreas are very rare. They may be classified as follows:—

1. *True cysts.*
   Acinous.—(i) Retention cysts; (ii) Cystadenomas, (a) multilocular (b) papillomatous; (iii) Congenital cystic disease.
   Interacinous.—(i) Lymphatic, (ii) Parasitic.
2. *Pseudo-cysts.*
   Intraperitoneal.—Inflammatory effusions into lesser sac, (a) the result of injury, (b) secondary to pancreatitis.
   Retroperitoneal.—The result of (i) old hæmorrhage or necrosis of pancreas, (ii) breaking down of a new growth.

Donoghue has drawn attention to certain parapancreatic cysts which spring from the neighbourhood of the tail and probably originate in the remains of the Wolffian body.

Pathology.—Of the **true cysts** those due to *retention* are the commonest. For the most part, they have been observed post mortem, and have presented no symptoms during life. Though usually the size of an orange, they may be as large as a man's head, or even attain enormous proportions necessitating surgical interference. The obstruction is in most cases a consequence of chronic interstitial pancreatitis.

The *cystadenomas* are still more rare. They may give rise to no symptoms during life, and only be discovered at necropsy, as in the example shown in Fig. 638, or one or more of the loculi may attain large size, giving rise to all the signs of pancreatic cyst.

Sometimes these tumours contain papillomas, while in other cases their structure suggests cystic epithelioma or carcinoma.

Congenital cystic disease also very rarely occurs, and is associated with the same condition in other organs.

Interacinous cysts.—Hydatids bear this relation to the gland, but are rare in the pancreas.

All the varieties of true cyst occur most commonly in the tail though they may be found in any part of the gland.

Pseudo-cysts.—If we dismiss the cystic conditions due to the softening and breaking down of malignant new growths, there are two principal conditions to be discussed under this head—(1) the retro-



Fig. 538.—Cystadenoma of the pancreas, lying near the tail of the gland. It will be noticed that the duct of Wirsung courses round the tumour. The smaller drawing is part of the tail of a pancreas the subject of chronic inflammation, and shows dilatation of the duct.

peritoneal collection of fluid in association with the breaking up of the pancreas from old hæmorrhage or inflammation (3) inflammatory effusions into the lesser peritoneal sac.

Jordan Lloyd first drew attention to the cases which follow on *injury* Laceration of the pancreas is combined with tearing of the overlying peritoneum, so that there is an escape of blood and pancreatic juice into the lesser sac. This leads to an inflammation, which results in the closing of the foramen of Winslow and the outpouring of a quantity of peritoneal fluid which adds to the effusion distending the lesser sac. When it is the result of disease, gall-stones, bile, and pancreatic fluid have been found in this situation.

The content of pancreatic cysts is an alkaline albuminous fluid, having a specific gravity of 1010 to 1020 It is either clear or a reddish-brown, or definitely blood-stained, and either watery or thick and syrupy and usually though not invariably contains one or more of the pancreatic ferments. The absence of ferments does not disprove a pancreatic origin, for this may be due to the fact that chronic disease of the gland interferes with its secretory function. When all three ferments are present, the fluid is certainly of pancreatic origin, but the presence of only one of the ferments is not diagnostic, for weak ferments occur in other body fluids.

Secondary changes.—In some cases hæmorrhage occurs into a cyst, either from injury or from erosion of vessels, and may later lead to the suggestion that such a cyst has arisen in connexion with an old hæmorrhage. Secondary infection may take place, and may lead to acute symptoms. Malignant disease may also arise, but this sequence is unusual.

Anatomical relations.—A pancreatic cyst sufficiently developed to be recognized may present in a variety of situations: (*a*) above the stomach, between it and the liver; (*b*) behind the stomach; (*c*) below the stomach, between it and the transverse colon; (*d*) below the transverse colon; (*e*) behind the stomach and colon; (*f*) between the layers of the mesocolon. The relations of a pancreatic cyst also depend on whether it springs from the head, the body or the tail of the gland.

An effusion into the lesser sac of the peritoneum (pseudo-cyst) (Fig 539) causes a general bulging of the epigastric and left hypochondriac regions with prominence of the lower part of the chest on that side; as it increases, the umbilical and left renal regions may be similarly invaded. The stomach is lifted forwards and pushed upwards, while the colon is thrust downwards and forwards against the belly wall. On the left the swelling impinges on the parietes just below the costal margin, the spleen being pushed up and the splenic flexure down, so that in this situation such an effusion can easily be reached by the surgeon.

Clinical features. — Cysts are generally found in adults, though they may occur even in infants. They are slightly more frequent in the female sex. Whereas true cysts commence gradually

and are often discovered accidentally pseudo-cysts invariably follow *injury or some acute inflammatory disturbance.*

In the true cysts the symptoms usually depend on the size of the tumour, and may merely be those of epigastric fullness or distress, or there may be nausea and vomiting, symptoms of intestinal obstruction, or jaundice from pressure on the bile-ducts. Pain, when present, often heralds secondary changes. As a rule, there are no characteristic urinary changes. The cysts feel soft and cystic when large, but firm and solid when small.

The history of the pseudo-cysts that arise as the result of injury

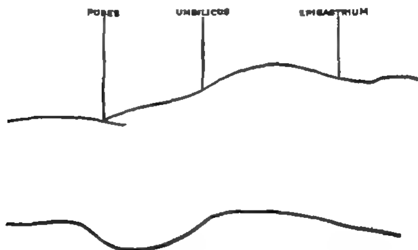


Fig 539—Profile outline of the epigastric swelling in a case of traumatic effusion into the lesser sac of the peritoneum.
("Brit. Journ of Surg")

is that of a blow or crush of the upper abdomen followed by severe pain, with signs of collapse, and with tenderness and rigidity in the epigastrium. These symptoms usually subside in the course of a day or two but later there is a return of the pain, accompanied by a sense of fullness in the upper abdomen here a swelling soon becomes obvious, and often so rapidly increases in size as to cause dyspnœa within a very few days. The history is not always so rapid, and there may be an interval of a week or even some months before a recurrence of pain and the appearance of a swelling reveal the nature of the case.

Diagnosis.—The diagnosis is usually a question of the differentiation of a cystic tumour in the upper abdomen, because, as a rule, evidence of interference with the pancreatic function is absent if present, however urinary or fæcal changes may be of great confirmatory value. X ray examination after a bismuth meal or enema may be of great help.

Prognosis.—In true cysts of the pancreas a spontaneous cure never occurs. The inflammatory effusions into the lesser sac may disappear without treatment, but generally tend to get rapidly worse.

Treatment.—Puncture or aspiration should never be employed as it involves a grave risk of sepsis or hæmorrhage, without any compensating advantage. Complete extirpation, though an ideal method, can seldom be satisfactorily carried out.

Drainage is the treatment most generally applicable and satisfactory The parietal abdominal incision should be made over the most accessible part of the cyst, usually in the middle line above the umbilicus. After protecting the general peritoneal cavity by gauze packing or by slightly withdrawing the cyst, if possible, from the abdomen, the surgeon evacuates the cyst and carefully examines its interior for secondary cysts or calculi. If the cyst can be brought to the surface, he then marsupialises it by stitching the edges of the opening to the abdominal wall if not, he must fix a dressed tube into the cyst by means of a purse-string suture, or failing this, must rely on careful packing to prevent leakage. The discharge will probably be scanty at first, but it soon becomes abundant and proteolytic In an ordinary case the track will close in about four to eight weeks but it may take much longer, sometimes several months. Great care must be exercised to prevent secondary infection, and for this purpose lumbar drainage has sometimes been found necessary but as a primary operation this can only be required in deep-seated cysts.

Diabetes may be associated with these cysts, or may follow on their treatment.

PANCREATIC FISTULA

This is usually a sequel to some operation on the pancreas, either for injury inflammation, or the treatment of a cyst.

The constant escape of secretion leads to digestion of the surrounding skin, which soon becomes extensively excoriated. Such a fistula may be very chronic, and may even resist treatment for years. Beyond the local inconvenience and the loss of secretion, the condition may be a source of septic absorption and of subsequent lardaceous disease. The amount of discharge varies with the character of the food taken, in response to the physiological excitation of the organ.

Treatment.—It is first necessary to see that there is no cause likely to keep the fistula active, such as a mass of sloughing pancreas. Drainage must not be hampered by too small an opening in the parietes it must be allowed to be free, and the surrounding skin protected by bland dusting powders and ointments. To lessen the discharge, Wohlgemuth recommends a carbohydrate-free diet with frequent small doses of bicarbonate of soda. Fats should be given plenteously

When the fistula is the result of the constant secretion from a cyst which cannot be removed, an anastomosis between such a cyst and the small intestine or stomach has been suggested and carried out.

To encourage closure of the fistula, Beck's bismuth paste may be used, or as a last resource, thorough cauterization may be employed. Excision of the track is not advisable. Sometimes when the fistula closes the cyst re-forms.

NEW GROWTHS

With the exception of cysts all tumours of the pancreas are comparatively rare. Of the simple tumours, *adenomas* and *cystadenomas* have been most often observed. Such tumours have been successfully removed.

Carcinoma

May be primary or secondary Primary cancer may be masked by the resultant enlargement of the liver. The growth may commence in any part, but is commonest in the head, where it may form a hard, nodular rounded mass the size of an orange, or it may be diffuse. A striking feature is the enormous dilatation of the gall-bladder which occurs when the bile-duct is compressed (Plate 103). Very often a cancer involving the head of the pancreas has had its origin in the glands, and not in the pancreas itself.

Clinical features.—The disease is more common in males, and usually occurs between the ages of 40 and 60. The cases can be separated into three groups, according to whether the bile-duct, the portal vein, or the duodenum is most involved. In each group the onset is insidious, and is often heralded by gastric disturbance. In the first group jaundice is the most prominent symptom—it comes on gradually and stealthily deepens without intermissions until the patient is of an olive-green colour with a pronounced tendency to hæmorrhage and an intolerable itching In some cases the itching precedes the jaundice in the second group ascites is the prominent feature and in the third, gastric symptoms depending on obstruction of the duodenum but, in any case jaundice is almost certain to appear at some stage of the illness Pain may be present, usually above the umbilicus and through to the back and in some cases it is a very prominent feature and may be agonizing. Unaltered fat or undigested muscle-fibres may be found in the fæces. Glycosuria is only present when the whole gland is involved, or when there is concomitant chronic pancreatitis. The absence of urobilin points to cancer

Diagnosis.—In gall-stones there is nearly always a history of previous attacks, an onset attended with pain, intermissions in the jaundice and an absence of palpable tumour or enlarged gall bladder. (Fig. 516 p. 748) Chronic pancreatitis may exactly simulate cancer



Enormous distension of the gall-bladder secondary to malignant disease of the head of the pancreas.

PLATE 103.

Garrod, Archibald, "The Diagnosis of Disease of the Pancreas, *Brit. Med Journ.*, April 3, 1920.
Halsted, W S., "Retrojection of Bile into the Pancreas a Cause of Acute Hæmorrhagic Pancreatitis"; and Opie, Eugene L. "The Etiology of Acute Hæmorrhagic Pancreatitis," *Johns Hopkins Hosp. Bull.* Nos. 121–3.
Handley Sampson, "Hunterian Lectures on Surgery of Lymphatic System," *Brit. Med. Journ.*, April 16, 1910
Kehr, Hans, "Die Praxis der Gallenwege Chirurgie, *Wort und Bild*, 1913; "Injuries and Diseases of the Liver and Biliary Passages," Bergmann's *System of Practical Surgery* vol. iv 1904.
Knox, Robert, *Radiography in the Examination of the Liver Gall Bladder and Bile-ducts*. 1920.
Kocher Th., trans. by Sir H Stiles, *Text Book of Operative Surgery*. 3rd English ed. 1911.
Körte, W., "Surgical Treatment of Acute Pancreatitis," *Ann. of Surg.*, Jan., 1912.
Lejars, Félix, trans. by W S. Dickie, *Urgent Surgery* 6th French ed. 1909.
Lloyd, Jordan, "Injury to the Pancreas: A Cause of Effusions into the Lesser Peritoneal Cavity," *Brit. Med Journ.*, Nov 12, 1892.
Love, McNeill, "Amœbic Abscesses of Liver" *Brit. Med. Journ.*, June 22, 1918.
Maccarty William Carpenter, "Pathology of the Gall Bladder and some Associated Lesions," *Ann. of Surg* May 1910
MacLaurin, C., "The Treatment of Hydatid of the Liver" *Brit. Med. Journ.*, Jan. 10 1914.
Mayo Clinics Collected Papers of from the inception to 1921 for many valuable contributions.
Mayo, William J., "Surgical Treatment of Pancreatitis," *Surg., Gyn. and Obstet.*, Dec., 1908. "A Review of Fifteen Hundred Operations upon the Gall Bladder and Bile Passages, with especial reference to the Mortality" *Ann of Surg.*, Aug., 1906.
Morison, R., "The Anatomy of the Right Hypochondrium relating especially to Operations for Gallstones, *Brit. Med. Journ.*, Nov 3, 1894.
Moynihan, Berkeley *Abdominal Operations*, vol. ii, 3rd ed. 1914. Revised, 1916 *Gall-Stones and their Surgical Treatment*. 1905.
Pringle, Hogarth, "Notes on the Arrest of Hepatic Hæmorrhage due to Trauma" *Ann. of Surg.*, Oct., 1908.
Robson (Mayo) and Cammidge, *The Pancreas its Surgery and Pathology*. 1907
Rogers, Leonard, "Lettsomian Lectures on Amœbic Liver Abscess," *Lancet* March 11 and 25, 1922.
Rolleston, Humphry *Diseases of the Liver Gall Bladder and Bile Ducts*. 2nd ed. 1912.
Thöle, F., "Chirurgie der Lebergeschwulste," *Neue Deuts. Chir.*, Bd. vii., 1913.
Turner, Grey, "Two Cases of Injury to the Pancreas," *Brit. Journ. Surg.*, vol. i., No. 4 1914. Local Discoloration of the Abdominal Wall as a Sign of Acute Pancreatitis," *ibid.*, vol. vii., No. 27 1920
White, Sinclair "The Surgical Treatment of Ascites Secondary to Vascular Cirrhosis of the Liver" *Brit. Med Journ.*, 1906.
Wynter W Essex, "The Treatment of Ascites by Continuous Drainage into the Tissues," *Arch. Middlesex Hosp* July 1909.

THE UPPER AND LOWER URINARY TRACT

By Sir JOHN THOMSON WALKER M B F R C.S

THE KIDNEY

Anatomy of the kidney—The kidney extends obliquely from the level of the middle of the 11th dorsal vertebra to that of the transverse process of the 3rd lumbar vertebra. Behind it lie the diaphragm, and the anterior layer of transversalis aponeurosis, which separates it from the quadratus lumborum muscle, the costo-vertebral ligament, and, at the lower pole the psoas. The pleura is in relation with the kidney between the diaphragmatic origin from the external arcuate ligament and the 12th rib. The anterior relations are shown in the accompanying diagram (Fig. 540)

The kidney lies embedded in a fatty capsule contained within the fascia propria or perirenal fascia. The perirenal fascia appears between the transversalis fascia and peritoneum, and divides at the outer renal border into an anterior layer which crosses in front of the kidney and great vessels, and a stronger posterior layer the fascia of Zuckerkandl, which, after supplying a fine covering to the renal vessels, becomes attached to the vertebral bodies. Above, the layers, after enclosing the suprarenal, become attached to the diaphragm; below the anterior layer lines the peritoneum, while the posterior layer is gradually lost in the extraperitoneal fat. The perirenal fascia thus forms an envelope open on its internal and inferior aspects. The true renal capsule closely invests the organ and enters the hilum, but is easily stripped from the surface.

The renal pelvis is the trumpet-shaped upper expansion of the ureter which enters the sinus of the kidney. It usually presents two primary divisions, each divided into calyces, and on the average can hold 3½ drachms though distension with more than 2 drachms causes pain.

The renal artery divides at the hilum; two or three branches pass in front of and one behind the pelvis. One of the anterior branches passes to the upper pole, sometimes without entering the hilum. The arterial supply is divided into an anterior and a posterior system, independent of each other. The least vascular line, or exsanguine line of Hyrtl, runs parallel to and a little *behind* the convex border and separates the anterior and posterior arterial systems.

An additional renal artery is present in about 20 per cent. of bodies, more commonly on the left side.

Lymphatics of the kidney.—The glands earliest affected in renal malignant disease are those at the hilum, those along the vena cava, and those between the aorta and the spermatic vein. The lymphatics from the hilum to the glands, along the great vessels, do not anastomose with neighbouring plexuses.

Attachments of the kidney.—The following structures, which prevent displacement, but allow free movement (3 to 5 cm.) with respiration, combine to support the kidney: (1) The renal vessels; (2) the peritoneum; (3) the attachment of the retroperitoneal surfaces of the duodenum, colon, and pancreas; (4) the adhesions to the suprarenal capsule; (5) the perirenal

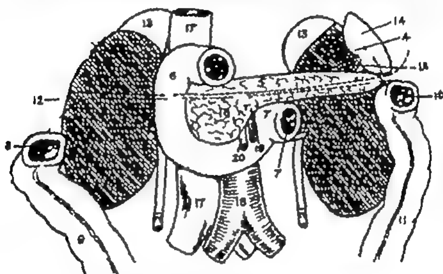


Fig. 540.—To illustrate the anterior relation of the kidneys (*diagrammatic*)

1 and 2, Peritoneum-covered surface of right kidney in apposition, respectively, with liver and small intestine; 3 to 5, peritoneum-covered surface of left kidney in apposition, respectively with stomach, spleen, and small intestine; 6, duodenum; 7, duodeno-jejunal junction; 8, hepatic flexure of colon; 9, ascending colon; 10, splenic flexure; 11, descending colon; 12, attachment of transverse mesocolon; 13, suprarenals; 14, gastric surface of spleen; 15, splenic vessels; 16, pancreas; 17, inferior vena cava; 18, aorta; 19, superior mesenteric artery; 20, superior mesenteric vein; ureters.

fascia and the network of fine fibres which pass to it from the renal capsule; (6) the perirenal fat; and (7) the fascia of Toldt, which connects the perirenal fascia on the right side with the hepatic flexure and the duodenum, and on the left with the splenic flexure. The intra-abdominal pressure also helps to prevent displacement.

THE RENAL FUNCTION

The function of the kidneys in disease may be estimated by observing symptoms of renal failure, by the examination of the urine, and by certain tests.

1. **Signs and symptoms of renal failure.**—Thirst is the most frequent symptom, and is more severe at night. The tongue is dry at first along the centre, and later over the whole surface. It becomes red, glazed, and cracked. In the later stages of urinary septicæmia it is covered with a

dry brown fur ("parrot tongue"). There are loss of appetite and inability to take solid food. Nausea and vomiting are late symptoms. There is frontal headache. The skin is dry and harsh, and the face has a peculiar yellow earthy look in the late stages. Emaciation is often present. Hiccup and drowsiness are grave symptoms. The temperature is subnormal in all aseptic cases and in chronic septic pyelonephritis.

2 **Examination of the urine.**—A persistently low specific gravity (1010 or less) is a grave symptom, and continuous reduction in the urea output shows a seriously impaired renal function. In some cases polyuria, in others oliguria or anuria, may be evidence of renal inadequacy

3. **Special tests of the renal function.** (*a*) Indigo-carmine test.—An intramuscular or intravenous injection of 4 c.c. of a 4-per-cent. solution of indigo-carmine is given and the urine is stained blue in twenty minutes after the first and in seven minutes after the second. The elimination reaches its maximum, the urine being a deep indigo blue, half an hour later, and should be complete in two hours. Delay in the appearance of the colour and failure to produce deep coloration are signs of a deficient renal function. This test may be used to investigate the total renal function, a catheter being placed in the urethra, or for the examination of the function of one kidney when the efflux from each ureteric orifice is watched with the cystoscope (chromo-cystoscopy).

(*b*) Phenol sulphone phthalein test.—Half an hour previous to the injection the patient drinks 300 c.c. of water An intravenous injection of 1 c.c. of a solution containing 6 mg. of phenol-sulphone-phthalein is given, and the urine collected in a test tube containing a drop of 25-per cent. NaOH solution. The commencement of elimination is noted, and the quantity excreted during the first and second hours is estimated by comparing the urine with a standard solution in a universal colorimeter Elimination should commence in from five to eleven minutes 40–60 per cent. of the drug should be excreted in the first hour 20–25 per cent. in the second hour.

When the total renal function is being investigated a catheter is placed in the urethra and the urine is allowed to pass until the dye begins to appear It is then removed, and passed at the end of the first and again at the end of the second hour Each specimen, after the addition of NaOH solution, is diluted by adding distilled water to one litre, and a sample placed in the colorimeter Where the function of one kidney is to be examined, a ureteric catheter is passed and a sample collected during the first twenty minutes only

(*c*) Urea-concentration test forced urea elimination.—The principle underlying this test is that after the administration of a large dose of urea the blood becomes overloaded with urea which the kidney is thus forced to eliminate. The renal function is measured by the quantity or the percentage (MacLean) of urea excreted. A dose of 15 grm. of urea in 100 c.c. of water is administered by the mouth, the urine secreted during each of the first three hours after the dose is collected separately and the percentage of urea in each specimen estimated. During the first hour some diuresis may be present, and the second and third-hour specimens are more important. An excretion of 2 per cent. or over is considered normal. When the reading is below 2 per cent. there is reduction in the renal efficiency and where the percentage is 1·5 or 1 there is serious impairment of the renal function.

Various forms of diuresis, unconnected with disease of the kidney must

be allowed for Normally about 120 c.c. of urine should be passed each hour

(*d*) Blood urea estimation.—The normal urea content of the blood is between 20 and 40 mg. per 100 c.c., but in advanced life 40 to 50 mg per 100 c.c. may not be considered abnormal (MacLean). A blood-urea reading of 75 to 80 mg. per 100 c.c. shows that there is renal inefficiency No rise in the blood urea is observed until there is advanced disease of the kidneys. By reducing the urea production (diet, rest) the blood urea may show a low reading, even when there is advanced disease of the kidneys. A high blood urea may be produced by nitrogenous diet, by diarrhœa or other causes. The blood urea estimation taken alone is not a reliable guide to the renal function. It should be considered with the urine-urea and with the urea-concentration test.

(*e*) Diastase test.—The normal urine contains ferment which changes starch into sugar (diastase). The diastase ferment produced by the pancreas is conveyed by the blood and excreted by the kidney The amount of diastase present in the urine varies with the activity of the kidney The diastatic activity of the urine is estimated by observing the amount of starch which a definite quantity of urine will change into sugar in a given time The disappearance of the starch is indicated by the failure to give a blue colour with iodine.

EXAMINATION OF THE KIDNEYS BY INSPECTION PALPATION AND PERCUSSION

A greatly enlarged kidney forms a rounded, unilateral abdominal swelling a little above the level of the umbilicus and more prominent in the recumbent posture. There is *fullness in the flank, but no projection backwards.* Where the renal pelvis is greatly distended with fluid a vertical groove may be seen on the surface of the swelling.

On palpation a renal *tumour presents rounded borders, without any* sharp edges, and frequently retains a reniform shape. It projects forwards into the abdomen, and backwards into the posterior kidney area at the angle between the *ribs and the spinal muscles. With the fingers in the loin,* the kidney tumour if small, can be projected against the anterior hand by a sudden push ("ballottement"). Unless fixed by adhesions, renal tumours descend *with inspiration, though rather less freely than tumours of the* spleen, liver, or suprarenal body The tumour can usually be separated from the liver, and seldom reaches the middle line.

Percussion gives a *dull note, merging into that of the spinal muscles* behind. Anteriorly there is a zone of comparative resonance, when the colon lies on the front of the tumour If the colon is collapsed and dull on *percussion, it can be rolled beneath the fingers. On the right side there* is usually an area of resonance between the renal dullness and that of the liver.

EXAMINATION OF THE URINE OF EACH KIDNEY—EXPLORATION

Examination of the urine of each kidney.—The urine of each kidney is obtained by catheterization of the ureters. The separators formerly used have now been entirely discarded. A fine catheter 30 in. in length, is introduced into the ureter *either through a specially constructed* cystoscope (catheterizing cystoscope) or through an open tube under the guidance of a reflected light (Kelly's tube). The bladder is washed and dis-

tended with 10 oz. of clear fluid, and the cystoscope, loaded with a catheter is introduced. The window is manœuvred into a position close to the ureter the catheter is gently inserted into the opening, and pushed gently on for 12 in. Then the other ureter is catheterized if a double-barrelled instrument is being used; or if a single-barrelled cystoscope is being employed it is withdrawn—leaving the first catheter in position—reloaded and reintroduced, and the second ureter catheterized. In direct catheterization of the ureters (Kelly's method), which is only applicable to the female bladder the urethra is dilated sufficiently to permit the introduction of a short wide speculum. The patient is then placed in the knee-chest position, so that the bladder becomes distended by atmospheric pressure. Any fluid which remains in the bladder is mopped up with pledgets of wool. Light is projected into the bladder either from an electric head lamp or reflected from a forehead mirror. The manipulation is made directly through the open tube.

Exploration of the kidney—Exploration of the kidney by operation may be necessary in the following cases: (1) To diagnose abdominal tumours of doubtful nature. Laparotomy will be the best method. (2) To ascertain the nature of disease already localized to the kidney An oblique lumbar incision and extraperitoneal examination of the kidney is advisable for this purpose. (3) To ascertain the extent and connexions of the tumour and the condition of the lymphatics in a large malignant growth of the kidney Either a lumbar extraperitoneal examination of the kidney combined with an exploration through an opening in the peritoneum in front of the colon, or a laparotomy alone, may be used. (4) To ascertain the presence and condition of the second kidney when one is diseased and nephrectomy is proposed. For this purpose cystoscopy and ureteral catheterization have replaced nephrotomy which is only required in the rarest cases, when these methods are rendered impossible by cystitis. Access is obtained through a lumbar incision, and the kidney is examined extraperitoneally by inspection, palpation, and incision, and, if necessary a slip of the kidney substance is removed and examined microscopically The abdominal route only permits of palpation, and has proved worthless.

POLYURIA

Continuous polyuria (80 to 100 ounces in twenty four hours) is observed in those forms of chronic interstitial nephritis which result from urinary obstruction or from other conditions, such as calculus and tuberculosis, that cause gradual destruction of renal tissue. The total quantity of urea and other urinary solids is much diminished. Nervous polyuria may be transient or may continue for some weeks or months; it is accompanied by indefinite abdominal pain and frequent micturition. The renal function is not impaired in nervous polyuria.

OLIGURIA AND ANURIA

Oliguria is a diminished secretion of urine, anuria a total cessation of the secretion. The types of oliguria and anuria may be classified thus:—

1. *Hysterical anuria.*
2. *Anuria due to changes in the general blood-pressure.*
3. *Reflex anuria*
   (i) Urethra.
   (ii) Bladder.
   (iii) Ureter.
   (iv) Kidney

4. *Infective anuria*
   (i) Hæmatogenous—(a) toxic.
   —(b) bacterial.
   (ii) Ascending urinary
5. *Urinary-tension anuria*
   (i) Obstruction—(a) gradually increasing.
   —(b) sudden.
   (ii) Sudden relief of hypertension.
6. *Anuria from destruction or removal of renal tissue*
   (i) Gradual destruction.
   (ii) Sudden complete destruction or removal.

1. Hysterical anuria.—Anuria may last for several hours or even days, but no symptoms of uræmia supervene. A copious polyuria immediately follows the anuria.

2. Circulatory anuria.—After severe, prolonged operations temporary oliguria or anuria may result from the low blood-pressure of shock, and also from the effect of the anæsthetic and the absorption of antiseptics. If the kidneys are diseased, this may initiate continuous and fatal anuria. In shock caused by grave injuries to the body and in the collapse of cholera, anuria is present.

3. Reflex anuria.—The passage of urethral instruments, especially if roughly used, or if necessitated by disease in the deeper part of the canal, may be followed by suppression of urine. The urethra may be healthy and its mucous membrane intact. The kidneys may show chronic nephritis or deep congestion, but sometimes they appear normal. There is usually a rigor with rise of temperature to 103° or 104 Fahr. In the majority of cases the symptoms are due to septic absorption, and in some to a combination of septic absorption and a reflex effect on the circulation of the kidneys, while in a few they are purely reflex in nature.

Surgical interference with the bladder may be followed by suppression of urine.

Reflex impulses from a ureter, started by a catheter or stone, may inhibit the secretion of the corresponding kidney. The function of both kidneys may be suppressed and complete anuria result owing to the lodging of a stone in one ureter or the kinking of the ureter of a movable kidney. The second kidney is always diseased. (*See* Calculous Anuria, p. 878.) Disease of one kidney such as pyelonephritis, may reflexly cause oliguria or temporary attacks of complete anuria.

4. Infective anuria. (i) *Hæmatogenous.*—In acute nephritis caused by a hæmatogenous infection, in septicæmia, influenza, pneumonia, typhoid fever and in auto-intoxication from gastro-intestinal infection, suppression of urine is frequently present, and may be fatal. Anuria following urethral operations is toxic in nature in many cases. In hæmatogenous infection of the kidney with the B. coli communis complete suppression may occur. (*See* Hæmatogenous Pyelonephritis, p. 842.)

(ii) *Ascending.*—An acute ascending infection of the kidneys may cause fatal anuria. Chronic septic pyelonephritis secondary to disease of the lower urinary organs is accompanied by oliguria, and complete anuria may supervene. (*See* Ascending Pyelonephritis, p. 842.)

5. Urinary pressure anuria.—Complete anuria may follow the sudden relief of urinary tension such as is caused by the quick emptying of an over-distended bladder. Rapid occlusion of both ureters by stone or

malignant disease also leads to complete suppression of the renal function. (See Calculous Anuria, p. 878.)

6. **Anuria from destruction or removal of renal tissue.**—The removal of a solitary kidney or of the only working kidney is followed by anuria, and death in a few days. If the second kidney is active, but incompetent from disease, the patient may survive the operation and die some months afterwards. When the kidney is slowly destroyed by disease there are attacks of partial or complete anuria, and finally complete suppression.

Treatment of anuria.—Hysterical anuria is treated by bromides, valerian, etc. Diuretics should be administered, and care exercised to prevent fraudulent disposal of any urine that is passed.

Circulatory anuria is treated by raising the blood pressure by means of camphor strychnine, ergot, adrenalin, and pituitary extract, and by saline infusion given by the rectum, or by subcutaneous or intravenous injection.

In *reflex* anuria the cause of the reflex inhibition should be removed (see Calculous Anuria, p. 878, and Pyelonephritis, p. 840). In *infective* anuria it may be necessary to incise one or even both kidneys (see Pyelonephritis). Sudden relief of long-established severe obstruction, as, for example, the rapid emptying of a chronically over-distended bladder in a case of enlarged prostate, should be avoided.

The following measures should be adopted in cases of anuria. Diuretics are administered, such as caffeine (5 gr.), diuretin (10 gr.), theocin sodium acetate (5 gr.), hot Contrexéville water and citrate of potash (15 gr.). Hot fomentations and poultices are applied over the loins, or the kidneys may be dry-cupped. The patient is placed in a hot pack or a vapour bath. In severe cases the introduction of one to two pints or more of glucose solution (2½ per cent.) into a vein has a powerful diuretic effect.

In urgent cases a pint of glucose solution (5 per cent.) is infused into a vein. In less urgent cases the injection may be given subcutaneously or intramuscularly or introduced into the rectum. Jeanbrau recommends an isotonic solution of glucose (47 grm. per 1,000), or of saccharose or lactose (90 grm. per 1,000).

BACTERIURIA (BACILLURIA)

Bacteriuria (bacilluria) is a condition of the urine in which bacteria are present in so great abundance that they render the fluid cloudy to the naked eye, yet inflammatory products are almost or entirely absent. Bacterial growth is excessive, and reaction minimal. Bacteriuria is found in infants and children, as well as in adults. Women are more frequently affected than men.

Pathology.—The B. coli is present in pure culture in over 80 per cent. of cases. The bacillus of typhoid is next most frequent; less frequent are the Staphylococcus albus, the Proteus vulgaris, the Streptococcus and the B. subtilis. These bacteria are usually present in pure culture. Bacteriuria may arise spontaneously or it may complicate some urinary disease.

In spontaneous cases a history of constipation or indigestion can usually be obtained, and pronounced phosphaturia may precede the bacteriuria. Other predisposing causes are chronic septic conditions of the mouth and throat, operations upon the rectum or anus, boils or carbuncles, appendicitis, and dysentery. Typhoid fever precedes the typhoid form, and other fevers, such as smallpox, diphtheria, scarlet fever and measles, may be accompanied by bacteriuria.

Bacteriuria may supervene during the course of chronic prostatitis or seminal vesiculitis, or it may immediately follow the passage of a sound or catheter. The bacteria gain admission to the urinary tract through the kidneys (hæmatogenous infection), or may be introduced into the urethra or bladder by instrumentation, or may ascend from the urethral opening in women and female children (urinary or ascending infection). The statement that they may pass directly through the rectal and bladder walls is unsupported by direct evidence. In uncomplicated cases, post-mortem examination has shown a complete absence of any lesion of the urinary mucous membrane.

Symptoms.—When passed the urine is hazy and frequently opalescent from the suspension of myriads of bacteria. On rotating a glass beaker so as to circulate the fluid, a peculiar and characteristic appearance like drifting mist or smoke is seen. The reaction is usually acid, occasionally neutral, and rarely alkaline. On centrifugalization, no deposit is obtained and the fluid remains cloudy. The urine has usually a strong fishy odour and contains a trace of albumin. Under the microscope the field is crowded with bacteria, usually the motile Bacillus coli. A few leucocytes may be found, and epithelial cells from the renal pelvis, ureter and bladder, or the prostatic urethra. The only constant sign is the bacterial emulsion in the urine. The urine may remain constantly cloudy for months or years, or it may suddenly clear, perhaps to become clouded again with equal suddenness.

There may be no symptoms at all, but signs of localized inflammation are seldom entirely absent. These consist in increased frequency of micturition, and urgency or scalding on passing water. In children, nocturnal enuresis may result. Frequently if the prostatic urethra or the prostate is the seat of the bacterial growth, the last few drops of urine are milky with bacterial emulsion, while the rest is merely hazy. In other cases the focus of bacterial growth is confined to the renal pelvis.

Prognosis.—In some cases bacteriuria is transient and appears for a few days only, rapidly disappearing under treatment. Usually, however, it continues with exacerbations and remissions for months or years. During this time the health of the patient may be uninfluenced, but there is the constant danger of a virulent bacterial inflammation arising in some part of the urinary tract.

Treatment.—This consists in the administration of urinary antiseptics and diluents, and in local treatment of the focus of inflammation and removal of the source of bacterial infection. Of urinary antiseptics the best are hexamine (15–30 gr. daily), oil of turpentine (15–30 minims daily) in capsule, hetraline or helmitol (20 gr. daily), and salol (20 gr. daily). The administration of diuretics with these antiseptics renders the urine less suitable for bacterial growth. Contrexéville, Vichy or Evian water may be given, or the patient directed to drink large quantities of distilled water or barley water.

Rovsing advises that a catheter should be retained in the urethra for a week or more while salol is administered by the mouth and large quantities of distilled water are drunk.

Where the focus of bacterial growth is confined to the prostatic urethra, *washing the bladder and urethra by Janet's irrigation* method may quickly relieve the symptoms and suppress the bacterial growth. The solutions suitable for this irrigation are permanganate of potash (1:10,000 to 1:5,000), oxycyanide of mercury (1:10,000), and nitrate of silver (1:10,000).

It is of the utmost importance to empty and regulate the bowel and

prevent further absorption. A course of artificially soured milk may be continued for several months.

Anti-coli horse-serum has been administered with some success in acute cases of B. coli infection of the urinary tract, and may be tried. A dose of 25 c.c. of the serum should be injected subcutaneously on three successive days. If improvement has not taken place at the end of that time, the treatment should be abandoned. Calcium lactate (20 gr. thrice daily) should be administered by the mouth to prevent the unpleasant effects of the serum. Treatment by vaccines gives varying results. In some cases the bacteria in the urine rapidly diminish in quantity and in a few cases disappear. Vaccines should be autogenous. In B. coli infections small doses of vaccine up to 10 or 15 million bacteria are less efficacious than higher doses of from 30 to 50 or even 100 million, which should be given at intervals of a week. The course should commence with small doses, and the doses should increase gradually.

Where the bacteriuria is superimposed on some pre-existing disease of the urinary tract, the latter should be suitably treated.

HÆMATURIA

An appearance resembling blood is given to the urine in hæmoglobinuria; and after the ingestion of some drugs, such as senna, rhubarb, sulphonal, etc. The final test for hæmaturia is the microscope. The urine in hæmoglobinuria has a peculiar purple colour, contains no clots, and shows no blood-corpuscles even after centrifugalizing.

Localization of the source of hæmaturia.—Blood from an area anterior to the compressor urethræ escapes from the meatus independently of micturition; that from any part behind this muscle is mixed with the urine and is only discharged with it.

Hæmaturia may be the solitary symptom, or it may be accompanied by localizing symptoms.

Severe pain in one kidney and ureteric colic will localize the hæmorrhage to this kidney, renal pelvis, or ureter; but dull aching in one kidney may be present in vesical disease such as papilloma and malignant growth.

Pain at the end of the penis on micturition points to an affection of the base of the bladder or of the prostatic urethra; while pain at the base of the sacrum, in the rectum, or in the perineum suggests the prostate.

Frequent micturition localizes the point of hæmorrhage to the prostatic urethra or bladder. Copious bleeding from the kidney may however cause vesical irritation and frequent micturition.

The combination of obstruction and hæmaturia is most frequently due to prostatic or urethral disease, but may result from a papilloma of the bladder near the internal meatus, or with a long pedicle, or even from temporary impaction of a clot in the urethra.

The longer the blood remains in contact with the urine, the more likely is it to be discoloured. The higher the source of blood in the urinary tract, the better the admixture with the urine. Blood in a highly acid urine is brownish, and in an alkaline urine bright red.

A brownish or smoky appearance of the urine indicates that the blood is small in quantity and well mixed with the urine, and the reaction acid. Such bleeding is usually renal in origin, and only forms a sediment after several hours. In coffee-coloured urine the source of bleeding is frequently the kidney or kidney pelvis, but may be the bladder or the prostate, especially if there is urethral obstruction. A purple tinge denotes venous bleeding, which may be derived from any part of the urinary tract. If the urine has a delicate

pink colour, the blood usually comes from the bladder or the prostatic urethra. Bright-red blood indicates copious bleeding from an arterial source, and may arise in any part of the urinary tract, most frequently in the bladder or prostate.

Blood appearing at the beginning of micturition (initial hæmaturia) usually comes from the prostatic urethra. Terminal hæmaturia (appearing at the end of micturition) is derived from the prostatic urethra or the bladder. No inference can be drawn as to the source of blood mixed with the whole of the urine (total hæmaturia).

Slender worm-like clots, 10 or 12 in. in length, are sometimes passed, and indicate the kidney or renal pelvis as the source of bleeding. More frequently however the clots passed from the ureter are small plugs, ½ in. in length. The blood may be rapidly passed into the bladder and there form irregular masses or flat clots, which indicate the position of coagulation, but not the source of the hæmorrhage. Urethral bleeding may form a cast of the urethra, which is discharged with the urine.

Albumin is present even where the amount of blood is very small. In cases of renal hæmaturia, however, the quantity of albumin exceeds the amount corresponding to the admixture of blood. If, on estimation, excess of the albumin over the proportion of 1·6 to 1 of hæmoglobin be found, this points to a renal cause of the hæmaturia (Newman).

In renal hæmaturia the corpuscles often appear as pale discs almost devoid of colouring matter while those added to the urine in the lower urinary tract are less changed.

Casts of the renal tubules, if present, indicate a renal lesion. Epithelial cells from the kidney pelvis, and ureter bladder, or urethra may be discovered and help to localise the source of the hæmorrhage.

The kidneys, ureters, and bladder should be examined by abdominal palpation, and the prostatic and membranous urethra, the prostate, seminal vesicles, bladder base, and lower ureters examined from the rectum.

Cystoscopic examination supplies a means of certain localisation. The bladder is thus examined for growths, stone, or ulcers, and the ureteric orifices for evidences of disease or staining of the efflux. The cystoscopic examination should be made during the attack of hæmaturia, so that if the hæmorrhage is renal the blood will be seen issuing from the ureteric orifice. Finally the ureters should be catheterized, and a sample of urine obtained from each kidney for microscopical examination (p. 818).

The **diagnosis of the cause of hæmaturia** will be described under the various diseases. The ultimate cause usually falls under one of the following pathological headings, viz. congestion, inflammation, ulceration, new growth, stone. If these be applied to the anatomical divisions of the urinary tract the commoner causes of hæmaturia will be enumerated.

Urethra.—Congestion of the verumontanum, acute inflammation (usually gonorrhœa), tuberculous ulceration of the urethra, simple papilloma and malignant growth, stone in the prostatic urethra.

Prostate.—Congestion (usually of an inflamed or enlarged prostate), prostatitis, tuberculous disease spreading into the prostatic urethra, malignant growth or simple enlargement, stone.

Bladder.—Congestion due to sudden relief of chronic retention of urine, acute cystitis, ulceration (tuberculous, staphylococcal, etc.), simple papilloma and malignant growth, stone, diverticulum (rare).

Ureter.—Acute ureteritis, tuberculous ulceration, new growths (rare), stone.

Kidney.—Congestion due to sudden relief in chronic vesical retention, nephritis (aseptic and septic), tuberculous ulceration, new growths, stone, movable kidney (rare), renal hæmaturia of obscure origin.

The last form cannot be referred to any single disease and will therefore be discussed here.

Renal hæmaturia of obscure origin.—This name has been given to a group of cases where hæmaturia has been localized to one kidney and where on operation and even nephrectomy no cause for the hæmaturia has been found. Careful microscopical examination of these kidneys, however frequently gives evidence of some degree of chronic nephritis; this occurs in scattered patches, and may therefore easily be overlooked. A few cases have been recorded in which hæmaturia without other symptoms and without albuminuria has been caused by a more extensive unilateral chronic nephritis (Poirier Loumeau).

A varicose condition of one or more of the renal papillæ as a cause of hæmaturia has been described by Fenwick, Whitney Pilcher and others. Its origin is doubtful; possibly it may result from a patch of interstitial nephritis similar to the condition just described. Profuse unilateral renal hæmaturia unaccompanied by other symptoms may be met with as an early symptom of chronic Bright's disease.

This form of hæmaturia is spontaneous, strictly unilateral, and not affected by rest or movement. The blood is abundant and well mixed, and gives the urine a dark, port-wine colour. Clots are very rarely formed. The bleeding may suddenly cease after some weeks or months, and may as suddenly reappear and become persistent. In the intervals no albumin can be detected nor tube-casts found. No bacteria are present in the urine. On the affected side there is occasionally a dull aching pain, uninfluenced by movement. The kidney is not tender or enlarged.

In 12 cases of unilateral symptomless hæmaturia in which I explored the kidney and removed a portion for examination, the microscope showed cortical patches of fibrosis of varying size in all. Newman has recorded a case of severe renal hæmaturia which preceded other symptoms of tuberculous disease by two years. Symptomless hæmaturia may occur in some growths of the kidney at a very early stage of their development.

Treatment of hæmaturia. — Only exceptionally is treatment, apart from operative measures, required for the cause of the hæmaturia. Morphia, calcium chloride or lactate, and hæmostatic serum may be used.

Local treatment.—In *renal hæmaturia* dry cupping and ice-bags may be applied over the kidney. Adrenalin has been injected into the renal pelvis through a ureteric catheter, 1 drachm of 1-in-5,000 solution being used.

In *vesical hæmaturia* a catheter should be passed and the bladder washed out with large quantities of hot boric solution or of a hot, very weak solution (1 : 15,000) of silver nitrate. Afterwards 10 or 12 oz. of a solution of antipyrin (10 per cent.), or 1 or 2 drachms of adrenalin solution (1 : 2,000), are injected into the bladder, left for a few minutes, and then run out. Any clots in the bladder may be washed out through a large catheter, or, better through a large evacuating catheter such as is used in lithotrity. The rubber lithotrity bulb may be attached and the clots sucked out. These methods should not be persisted in for long; if the clots are large, and distending the bladder, suprapubic cystotomy should be performed, the clots cleared out, and a stream of hot boric solution (115° to 120° F.) passed through a catheter in the urethra, and allowed to well out of the suprapubic opening.

In a case of *unilateral renal hæmaturia* nephrotomy is necessary, and if a papilla of the kidney shows congestion it may be cut away with a sharp spoon. Where nephrotomy fails to discover any lesion in the renal substance the wounds in the kidney and renal pelvis should be closed with catgut

sutures. The hæmaturia in the majority of cases ceases after the exploration apparently as a result of pressure upon the bleeding vessel by the sutures. Nephrectomy should not be performed for this reason, and also because bilateral nephritis may give rise to unilateral hæmaturia. Very rarely recurrence of hæmorrhage necessitates a second operation.

Decapsulation may be combined with nephrotomy but the results are similar to those of nephrotomy alone, the hæmaturia recurring in rare cases

PYURIA

Pyuria indicates inflammation in one or more parts of the urinary tract. Bacterial infection may occur in an otherwise healthy urinary tract, or may be superadded to stone, stricture, growth, or other gross lesions. Further one bacterial inflammation may be superimposed upon another of a different character.

Apart from acute inflammation of the urethra, the position of which will be evident from the discharge of pus at the meatus, the largest quantities of pus are derived from purulent collections in the kidney In cases of long standing bladder inflammation the total quantity of deposit may be large, but the proportion of pus is not so great. The fluffy muco-purulent deposit of urethritis settles quickly to the bottom of the glass, while that of cystitis forms billows in the urine, which is usually highly coloured and concentrated. In severe old-standing cystitis the urine may look like coffee with milk. The sediment, after standing for an hour or two, is viscous and clings like slime to the bottom of the vessel. Pus from the renal pelvis, or from a dilated kidney produces a milky urine when passed, but later lies at the bottom as a heavy flat, yellowish layer which rolls heavily to the lowest part when the vessel is canted. The supernatant fluid is cloudy with suspended pus or bacteria.

The urine is usually pale and of low specific gravity Suppurative renal disease combined with cystitis produces a solid layer of pus at the bottom of the glass, and above this a layer of billowy fluffy muco-pus.

In chronic cystitis the urine has a pungent ammoniacal odour. As a rule, purulent urine from the kidney has no characteristic odour but a purulent collection in a dilated kidney may be offensive, and a pyelitis with excessive bacterial growth may possess a very strong disagreeable and penetrating smell. B. coli, the gonococcus, and B. typhosus produce acute cystitis, in which the purulent urine remains acid. The tubercle bacillus produces a subacute or chronic cystitis with an acid urine. The staphylococcus, streptococcus, and B. proteus cause ammoniacal decomposition of the urine. The urine from a case of suppurative pyelitis is usually acid, but ammoniacal decomposition may take place.

Pus appearing at the beginning of micturition has a urethral origin. When the urine is clear at the beginning of micturition and purulent at the finish, the pus comes from the prostate or bladder.

Intermittent pyuria in large quantity is found in pyonephrosis, and also when an abscess or an infected vesical diverticulum repeatedly discharges into the urethra or bladder

Albumin proportional to the quantity of pus present is found in the urine of all uncomplicated cases of pyuria. If it be present in excessive quantities, renal complications may be suspected.

Epithelial elements may be present in the urine, but have less [illegible]ficance in regard to localization here than in hæmaturia. Tube casts [illegible] und in the slighter forms of pyelonephritis.

Localizing symptoms m[illegible] ent which point to t[illegible] the

pyuria. The cystoscope will frequently localize the otherwise obscure origin of pyuria. The examination of the ureteric orifices should never be neglected. Disease of the bladder *exclusively surrounding one ureteric orifice*, changes at the orifice itself, and the observation of murky or purulent urine coming from one ureter will show that there is disease of the kidney whether renal symptoms be present or not. When the quantity of pus in the urine is small and the bladder inflamed it may be very difficult to distinguish the pyuria by examining the ureteric efflux, and ureteral catheterization will then become necessary. When the pus is present in quantity with *little* urine, pipes of semi-solid pus are observed issuing from the ureteric orifice.

In some cases of longstanding pyuria, radiography shows the presence of stones in one or both kidneys, when no symptoms of their presence have been observed.

PNEUMATURIA

In this condition gas is discharged with the urine at the end of micturition. Pneumaturia may result from the introduction of air into the bladder during instrumentation, from the escape of intestinal gas through a vesico-intestinal fistula, or rarely from spontaneous development of gas in the urinary tract. This may be due to liberation of CO_2 by fermentation of sugary urine through the action of B. coli, or occasionally Proteus vulgaris; in non-glycosuric cases the gas has been said to be derived from the blood or from gaseous decomposition of the urine by gas-producing bacteria such as the colon bacillus.

Treatment.—When no fistula exists, treatment consists in removing the cause of the fermentation by washing the bladder and administering urinary antiseptics. Glycosuria should be treated. The treatment of fistula of the bladder will be discussed later (p. 923).

CONGENITAL ABNORMALITIES OF THE KIDNEY AND URETER

Fœtal lobulation of the kidneys occasionally persists throughout life. Complete absence of both kidneys has been found in acephalic fœtuses. Supernumerary kidneys are rare. A third kidney has occasionally been found.

Absence or Atrophy of One Kidney

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sutures. The hæmaturia in the majority of cases ceases after the exploration apparently as a result of pressure upon the bleeding vessel by the sutures. Nephrectomy should not be performed for this reason, and also because bilateral nephritis may give rise to unilateral hæmaturia. Very rarely recurrence of hæmorrhage necessitates a second operation.

Decapsulation may be combined with nephrotomy but the results are similar to those of nephrotomy alone, the hæmaturia recurring in rare cases.

PYURIA

Pyuria indicates inflammation in one or more parts of the urinary tract. Bacterial infection may occur in an otherwise healthy urinary tract, or may be superadded to stone, stricture, growth, or other gross lesions. Further, one bacterial inflammation may be superimposed upon another of a different character.

Apart from acute inflammation of the urethra, the position of which will be evident from the discharge of pus at the meatus, the largest quantities of pus are derived from purulent collections in the kidney. In cases of long-standing bladder inflammation the total quantity of deposit may be large but the proportion of pus is not so great. The fluffy muco-purulent deposit of urethritis settles quickly to the bottom of the glass, while that of cystitis forms billows in the urine, which is usually highly coloured and concentrated. In severe old-standing cystitis the urine may look like coffee with milk. The sediment, after standing for an hour or two, is viscous and clings like slime to the bottom of the vessel. Pus from the renal pelvis, or from a dilated kidney produces a milky urine when passed, but later lies at the bottom as a heavy flat, yellowish layer which rolls heavily to the lowest part when the vessel is canted. The supernatant fluid is cloudy with suspended pus or bacteria.

The urine is usually pale and of low specific gravity. Suppurative renal disease combined with cystitis produces a solid layer of pus at the bottom of the glass, and above this a layer of billowy fluffy muco-pus.

In chronic cystitis the urine has a pungent ammoniacal odour. As a rule, purulent urine from the kidney has no characteristic odour, but a purulent collection in a dilated kidney may be offensive, and a pyelitis with excessive bacterial growth may possess a very strong disagreeable and penetrating smell. B. coli, the gonococcus, and B. typhosus produce acute cystitis, in which the purulent urine remains acid. The tubercle bacillus produces a subacute or chronic cystitis with an acid urine. The staphylococcus, streptococcus, and B. proteus cause ammoniacal decomposition of the urine. The urine from a case of suppurative pyelitis is usually acid, but ammoniacal decomposition may take place.

Pus appearing at the beginning of micturition has a urethral origin. When the urine is clear at the beginning of micturition and purulent at the finish, the pus comes from the prostate or bladder.

Intermittent pyuria in large quantity is found in pyonephrosis, and also when an abscess or an infected vesical diverticulum repeatedly discharges into the urethra or bladder.

Albumin proportional to the quantity of pus present is found in the urine of all uncomplicated cases of pyuria. If it be present in excessive quantities, renal complications may be suspected.

Epithelial elements may be present in the urine, but have less significance in regard to localization here than in hæmaturia. Tube casts are only found in the slighter forms of pyelonephritis.

Localizing symptoms may be present which point to the source of the

pyuria. The cystoscope will frequently localize the otherwise obscure origin of pyuria. The examination of the ureteric orifices should never be neglected. Disease of the bladder exclusively surrounding one ureteric orifice, changes at the orifice itself, and the observation of murky or purulent urine coming from one ureter will show that there is disease of the kidney whether renal symptoms be present or not. When the quantity of pus in the urine is small and the bladder inflamed it may be very difficult to distinguish the pyuria by examining the ureteric efflux, and ureteral catheterization will then become necessary. When the pus is present in quantity with little urine, pipes of semi-solid pus are observed issuing from the ureteric orifice.

In some cases of longstanding pyuria, radiography shows the presence of stones in one or both kidneys, when no symptoms of their presence have been observed.

PNEUMATURIA

In this condition gas is discharged with the urine at the end of micturition. Pneumaturia may result from the introduction of air into the bladder during instrumentation, from the escape of intestinal gas through a vesico-intestinal fistula, or rarely from spontaneous development of gas in the urinary tract. This may be due to liberation of CO_2 by fermentation of sugary urine through the action of B. coli, or occasionally Proteus vulgaris; in non-glycosuric cases the gas has been said to be derived from the blood or from gaseous decomposition of the urine by gas-producing bacteria such as the colon bacillus.

Treatment.—When no fistula exists, treatment consists in removing the cause of the fermentation by washing the bladder and administering urinary antiseptics. Glycosuria should be treated. The treatment of fistula of the bladder will be discussed later (p. 923).

CONGENITAL ABNORMALITIES OF THE KIDNEY AND URETER

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In 93 cases which I collected of death from uræmia or anuria after an operation on one kidney the second kidney was absent in 10 and completely "atrophied" in 8. Unsymmetrical kidney and extreme congenital atrophy of the kidney occurs in 1 in 2,400 bodies (Morris). The left kidney is more frequently absent than the right, and male subjects are more often affected than female in the proportion of 2 to 1. The renal vessels on the affected side are absent or rudimentary and the ureter is absent (93 per cent.) or is represented by a solid fibrous cord attached to the bladder. The corresponding half of the vesical trigone is atrophied. The ureteric orifice may be undiscoverable, but occasionally shows as a small dimple or even as an opening into a lumen extending from 1 to 2 cm. In 70·8 per cent. of cases there is some associated congenital malformation in the genital system, almost always on the same side. Other congenital malformations have also been noted, such as hare-lip, web-fingers, etc.

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Extreme congenital atrophy is very rare, but a less complete form is more frequently observed. The condition is usually due to loss of function of the kidney from blocking of the ureter or disease of the kidney itself. In congenital atrophy some rudiment of the kidney is always found, and the ureter is present, although sometimes merely as a fibrous cord.

Dangers and diagnosis of solitary kidney.—A single kidney is prone to be attacked by disease such as calculus, malignant growths, tuberculosis, and chronic nephritis. Apart from this, however, the condition does not shorten life.

It is imperative that proof of the presence of an active second kidney be obtained whenever nephrectomy is proposed. Congenital malformation of the generative organs is present in 70·6 per cent. of these cases, and should lead to a thorough investigation of the second kidney.

On cystoscopy the ureteric orifice is absent in 33 per cent. of cases. When a ureteric orifice is present the ureter should be catheterized, or an intramuscular injection of indigo-carmine given and the ureteric orifice watched for a dark blue efflux (see p. 817). Finally lumbar exploration of the kidney should be carried out when the previous methods have failed. Abdominal exploration has proved fallacious.

Fused Kidneys

Fusion of the kidneys into one mass gives rise to an organ presenting a great variety of sizes and shapes. The lowest degree of fusion is when two kidneys are united by a fibrous band, and the highest when two kidneys are indistinguishably fused in a single mass. The following names have been applied to the various shapes, viz. horse-shoe kidney, S-shaped kidney, long kidney, shield-like kidney, discoid kidney.

The *horse-shoe kidney* is the most common degree of fusion—1 in 1,000 bodies (Morris). The kidneys are united by a band passing between the lower, very rarely the upper, poles across the aorta and vena cava. The fused kidneys lie nearer the middle line than normal, and are displaced downwards, the uniting band frequently lying as low as the bifurcation of the aorta. The bond of union varies from a flat band of fibrous tissue to a definite bridge of renal tissue. The blood vessels of each kidney are frequently increased in number and abnormal in distribution; the ureters pass down in front of the uniting band. Diagnosis is very rarely made before operation. It depends upon the discovery of a horse-shoe-like swelling in front of the lumbar vertebræ, and the discovery of a hydronephrosis or of shadows of calculi which lie nearer the middle line than usual. This malformation has been mistaken for a malignant growth.

In unilateral fused kidney the ureters may open in the normal position and lead to the view that two normal kidneys are present.

The course of the ureters can be demonstrated by passing into each a bougie opaque to the X rays.

Fixed Misplacement of the Kidney

The fixed misplaced kidney is occasionally normal in size and contour but usually shows considerable malformation. The remaining kidney, if not fused, is sometimes absent or atrophied.

The misplaced kidney is found at the bifurcation of the aorta, on the promontory of the sacrum, over the sacro-iliac synchondrosis, in the iliac fossa, or the hollow of the sacrum. The suprarenal capsule accompanies it.

If one kidney only is misplaced, it is usually the left. The renal vessels

are, as a rule abnormal in origin, number and distribution; malposition of the colon and rectum and genital malformations are frequently present.

Symptoms and diagnosis.—Disease of a misplaced kidney frequently gives rise to pain in the corresponding lumbar region, and this may distract attention from the real cause of the symptom. Renal misplacement seldom causes symptoms *per se*. In women a pelvic kidney may disturb menstruation, pregnancy and parturition. The diagnosis will rest upon the discovery of a tumour on the promontory or in the pelvis, the absence of the kidney from the same side, and sometimes upon signs of renal disease in the urine. Tumours of the pelvic organs, especially ovarian cysts, and also hydatid cysts must be excluded. The rectum may be shown by air inflation to pursue an abnormal course. A very short ureter has been observed on catheterization. Psychic disturbances have been noted. A doubtful tumour in this situation usually necessitates a laparotomy for diagnosis.

Treatment.—When the existence of a second efficient kidney has been certainly ascertained, the presence of pronounced symptoms justifies removal of the misplaced organ.

CONGENITAL ABNORMALITIES OF THE RENAL PELVIS AND URETER

The renal pelvis may bifurcate into its upper and lower branches before entering the renal hilum, or may even sometimes show a third primary division. Unilateral duplication of the ureter occurs in 4 per cent. of bodies; it may affect a part or the whole length of the tube which may open into the bladder by one or two apertures.

The ureter which drains the upper part of the kidney usually crosses that from the lower part, and opens lower on the trigone.

Bilateral double ureters are of less frequent occurrence. Five and even six ureters have been found in one individual.

The ureter may be congenitally misplaced and open into the male prostatic urethra or seminal vesicle, into the female urethra or vagina, or into the rectum. The misplaced ureter is usually a supernumerary one, and the ureteric orifice is narrowed and sometimes ends blindly in the form of a cyst in some part of the bladder wall. In the female subject, incontinence of urine while the patient could pass a quantity of water voluntarily has been noted when a ureter opened into the urethra. The ureter should be transplanted into the bladder in such cases.

Congenital narrowing of the ureter leads to hydronephrosis or to atrophy of the kidney

MOVABLE AND FLOATING KIDNEY

The normal respiratory excursion of the kidney varies from ½ to 1¼ in.

Pathological anatomy.—A *floating* kidney is entirely surrounded by peritoneum, which also clothes its pedicle and forms a mesonephros. It is a very rare congenital malformation, and cannot be diagnosed from a movable kidney without operation an intraperitoneal operation is required for its relief. A *movable* kidney moves within the thickened perirenal fascia behind the peritoneum. The delicate perirenal fat is diminished or entirely absent, and the fibrous

threads connecting the fibrous capsule of the kidney with the perirenal fascia are thickened and elongated. Milky patches of thickening are frequently observed on the fibrous capsule. The renal vessels are elongated, the artery more so than the vein. The suprarenal body does not move with the kidney The attachments of the kidney to the duodenum and the ascending colon on the right side and to the pancreas and the descending colon on the left are usually separated. Thick bands of adhesions between the kidney and colon may however, be found. The kidney occasionally becomes adherent in an abnormal position such as the iliac fossa.

Torsion of the vascular pedicle may occur even when the excursion of the kidney is moderate. The renal vein is obstructed, and the organ becomes engorged with blood, enlarged and dark purple with subcapsular hæmorrhages.

Kinking or twisting of the ureter may be caused by swinging of the kidney or by its rotation on its transverse axis and twisting of the ureter over the renal vessels. The pelvis becomes distended with urine. Repetition of such attacks induces hollowing of the kidney and intermittent hydronephrosis

Undue mobility of the kidney may exist alone or may be merely part of a general visceroptosis. The stomach is frequently dilated. Movable kidney may be the seat of interstitial nephritis, stone, tuberculosis, or new growth.

Etiology.—The average age is 33½ years (McWilliams). Movable kidney occurs in from 5 to 10 per cent. of women and from ½ to 1 per cent. of men. The right kidney is affected in 8 out of every 10 cases. Both kidneys are affected in 5 per cent. of cases. No single cause satisfactorily explains the occurrence of abnormal mobility of the kidney in all cases. The following factors are of importance —

1. *Congenital mobility* is rarely observed.

2. *Anatomical factors*—The kidneys lie in shallow recesses, one on each side of the vertebral bodies, the paravertebral fossæ. Wolkow and Delitzen state that persons with movable kidneys have shallow para vertebral fossæ which are open at the lower end. In women they are shallower and more open than in men, and on the right side more than on the left.

Mansell Moullin holds that there is a slight rotation of the vertebræ to the right in a large number of right sided people, and this makes the right lumbar recess shallower.

The liver does not cause downward displacement of the right kidney

3. *Atrophy of the perirenal fat* is found in many cases.

4. *Weakness of the abdominal walls.*—Glénard states that general visceroptosis always accompanies movable kidney and results from

weakness of the abdominal wall. This is disproved by statistics and experience.

5 *Injury and pressure.*—In 11 4 per cent. of cases there is a distinct history of a blow severe muscular strain, or other injury in the region of the kidney The wearing of corsets does not produce movable kidney

6 *Drag of adhesions between kidney and bowel*—Bands of adhesions probably the result of chronic constipation, pass between the kidney and the colon, and the drag of these is a cause of movable kidney (Arbuthnot Lane).

7 *Pathological conditions of the kidney*—Tumours, hydronephrosis, calculus, and other diseases may coexist with movable kidney and in some cases appear to be a factor in the causation of the mobility.

Clinical features.—Mobility of the kidney even with wide range of movement, may be unaccompanied by symptoms.

1 Symptoms referred to the kidney (*a*) *Pain and discomfort.*—There is renal pain of a heavy aching character and attacks of acute pain may occur followed by enlargement and tenderness of the kidney The pain is initiated and aggravated by movement and relieved by rest it is increased during the menstrual period.

(*b*) *Undue mobility*—In slight degrees of mobility the kidney usually moves parallel with the vertebral column, but it may swing round so that the lower pole approaches the bodies of the vertebræ—"cinder-sifting movement" (Morris) In another form the upper end of the kidney falls forward, while the lower end remains in contact with the posterior abdominal wall. In the wider ranges of movement the kidney descends below the costal margin, at first vertically and then the lower pole swings towards the vertebral column so that the hilum faces upwards. Exceptionally the pedicle is so long that the kidney may be found in almost any part of the abdomen, and may descend into the true pelvis.

The movable kidney is uninfluenced by respiratory movements, and escapes from the grasp with a sudden slip that is characteristic, the patient experiencing a sickening sensation. The tumour can be reduced into the loin, and is then no longer palpable.

(*c*) Some *lack of resistance* is detected in the loin of the affected side when the patient is examined on her hands and knees.

(*d*) *Enlargement of the kidney*—Intermittent hydronephrosis not infrequently results from abnormal mobility

(*e*) *Changes in the urine.*—Hæmaturia is rare, but it may follow muscular exertion. Albuminuria is frequently observed, and disappears on resting. Tube casts due to venous congestion are present in the urine in 8 out of 180 cases (Newman). Transient polyuria coincides with the relief of an attack of hydronephrosis. Anuria may

result from torsion of the renal pedicle, and has been known to last for nine days without ill after-effects.

Frequent micturition may be reflex during an attack of pain, or the result of polyuria after an attack of hydronephrosis.

2 **Symptoms referred to other organs.** (*a*) *Gastro-intestinal symptoms.*—There may be epigastric pain and burning unconnected with the taking of food. The patient complains of a sinking sensation, loss of appetite, nausea, eructations, a feeling of distension, and vomiting, and becomes thin and anæmic. In such cases the stomach is usually distended, and may be displaced the right kidney is movable and the condition is due to the drag of adhesions on the second part of the duodenum or of a thickened band of peritoneum on the pylorus. Recurrent attacks of flatulent distension of the colon and constipation, perhaps resembling intestinal obstruction, may be caused by adhesions between the kidney and large intestine. Jaundice, epigastric pain, and distension of the gall bladder may repeatedly occur they have been ascribed to pressure of the kidney on the common bile-duct, or to dragging of the kidney upon the second part of the duodenum.

(*b*) *Nervous symptoms*—Mobility of the kidney is often accompanied by neurasthenia of various degrees, and is considered by Suckling to be a cause of some forms of insanity

Dietl s crises.—The patient is liable to crises which may be due to dragging on adhesions connected with the pylorus or bowel or to torsion of the vascular pedicle or kinking of the ureter The attack may follow a muscular effort. (*a*) When the stomach or bowel is affected there is severe epigastric or general abdominal pain. Vomiting and collapse are usual. The abdominal muscles are rigid, especially on the side of the movable kidney Later the abdomen becomes distended and tympanitic The bowels are constipated, and the temperature may be raised. (*b*) When the ureter is obstructed the kidney becomes large and tender the urine is diminished and there may be complete anuria. The attack lasts some hours or even days. (*c*) With torsion of the renal pedicle there are again acute abdominal symptoms. In addition the urine becomes scanty albuminous, and sometimes bloody and complete suppression may supervene. The kidney is painful, large, and tender Polyuria may follow the attack, and the urine contains blood, and hyaline, granular and blood casts.

Diagnosis.—The following conditions may give rise to difficulty in diagnosis —

1. *A distended gall-bladder*—The presence of jaundice, the constantly palpable tumour the restricted range of movement, the area of dullness blending with that of the liver the absence of a bowel note in front of the tumour are characteristic of the distended gall-bladder.

2. *Riedel's lobe of the liver*—The respiratory movement is the same

as that of the liver and greater than that of the kidney the dullness is continuous with that of the liver and the edge of the swelling is sharp

3. *Small ovarian tumour with a long pedicle.*—This can be reduced into the pelvis, but not into the loin the pedicle is attached below and can be demonstrated from the vagina.

4. *Malignant growth of the intestine.*

5. *Scybalous masses in the intestine*

In doubtful cases an opaque catheter should be passed up the ureter the pelvis of the kidney filled with sodium bromide solution (20 per cent.) and a radiogram obtained.

Treatment.—Operation is imperative—(1) where the mobility is causing disease of the kidney (2) where the kidney is exerting harmful traction on other organs (3) where the kidney lies below the waist line and is uncontrolled by a mechanical apparatus (4) when the patient is going to reside in tropical or uncivilized countries (5) where the patient has to perform manual labour and cannot afford an expensive apparatus. But in most cases palliative treatment may be tried before resorting to operation. Operation is most successful in cases where the symptoms are relieved by rest in the recumbent position.

Operative treatment is likely to fail—(1) where general visceroptosis is present (2) where there is severe neurasthenia and no symptoms can be referred to the kidney

In a few cases of movable kidney with neurasthenia, control of the renal movements by a mechanical apparatus will alleviate or cure the neurasthenia, and in these cases also operation will be followed by a similar result.

Palliative treatment 1. *By rest and by increasing the body fat.*—It is hoped to obtain an increased deposit of fat around the kidney but this does not obtain in practice. This treatment is, however, a useful adjunct to other methods. In severe cases the full Weir Mitchell treatment should be insisted upon.

2. *By mechanical apparatus.*—The kidney truss exerts pressure upwards and outwards by a thin padded metal plate (Ernst) It must be applied lying down.

The kidney belt is an abdominal belt coming down over the iliac crest and accurately moulded to the hips. The lower border follows the curve of the groin and overlaps the pubic bones. There is an elastic inset on each side, and perineal straps are attached. An oval or horseshoe-shaped kidney pad is added. The belt must be applied when the patient is lying down. It may be fitted to the lower part of a corset.

The corset for movable kidney (Gallant) is accurately fitted. Below

the waist it is inflexible and elastic above the waist it permits free play of the trunk.

Operative treatment.—The kidney is exposed by an oblique lumbar incision or by a vertical incision along the outer border of the erector spinæ muscle. The kidney is then fixed—(*a*) By sutures passing through the kidney capsule or through the kidney substance, carried through the muscles of the abdominal wall at the upper edge of the wound, and tied. (*b*) By stripping the capsule of the kidney (decortication) (*c*) By stitching the stripped capsule to the parietes the capsule may be rolled up on the anterior or posterior surface, or split into wedges or strips. (*d*) By partial stripping and by sutures through the substance of the kidney (*e*) By placing strips of gauze below the lower pole to promote granulation and cicatrization. (*f*) By the formation of a shelf of peritoneum or fibrous capsule this may be done by stitching through the parietal peritoneum and abdominal muscles below the kidney after opening the peritoneal cavity (Bishop) or by reflecting a strip of fibrous capsule and stitching it below the kidney without opening the abdomen (Watson Cheyne).

Results.—The operative mortality is stated at 1 per cent. but it is lower than this in skilled hands. In 116 cases examined not less than three months after operation, Keen found that 57·8 per cent. were cured and 12 9 per cent. improved, while in 19·8 per cent. the operation had failed. Failure consisted either in recurrence of the mobility or in persistence of the pain.

INJURIES TO THE KIDNEY

1 Injuries without External Wound

The right side is more often affected than the left and the injury is rarely bilateral.

Etiology—Rupture of the kidney may be due to a direct blow kick, or squeeze, or to indirect violence, as in a fall from a height on to the buttocks, or in forcible acute flexion of the body when the kidney may be injured by impact against the 12th rib or the transverse process of a vertebra.

Pathology—There may be tearing of the fatty capsule alone, with perirenal hæmorrhage and subsequent formation of fibrous tissue, or a slight subcapsular rupture of the kidney with accumulation of blood beneath the fibrous capsule, or a laceration of both fibrous capsule and kidney substance which may reach the renal pelvis. The tears radiate transversely from the hilum, and affect especially the anterior surface and lower pole, but may be complete. Sometimes the ureter or a large branch of the renal artery is ruptured. Laceration of the renal pelvis or ... x is common.

The peritoneum may ... orn, and blood and ... into the peri-
toneal cavity. This ... frequently in ch ... the protective
layer of perinephric ... veloped before th ... Ribs may
be fractured, or the ... pelvic girdle b ... een, bladder
or lungs injured. ... ce rapidly in ... Infection
and suppuration os ... tic abscess, ... hritis, pyo-
nephrosis, and perito ... ·3 per cent.

Symptoms.—Shock is present in all severe grades of rupture. It may be delayed for some hours, so that the patient may walk a considerable distance after the accident, and only collapse when he sees blood in the urine. Pain radiates along the ureter and is accompanied by retraction of the testicle. It is especially severe when clots are passing along the ureter There is also dull, heavy deep-seated pain, increased by pressure and movement. The abdominal muscles are rigidly contracted. Soon after the injury or some days later, a tumour due to perirenal effusion of blood appears in the loin. It is dull on percussion and tender on palpation, and may be movable (pseudo-hydronephrosis). It is usually diffuse and obscured by rigidity of the muscles. If the swelling is clearly outlined and "ballottement" can be obtained, the renal pelvis has been distended with blood and a hæmatonephrosis formed.

Hæmaturia is present in 91·5 per cent. of cases. It is absent when the rupture does not penetrate the renal pelvis or calyces, when the ureter is plugged with clot or ruptured by the violence. Blood may be delayed for some days. In half the cases it has disappeared in a week, but it may persist and appear intermittently for several weeks and may be fatal after two to three weeks. In copious bleeding there is clotting in the bladder with retention of urine.

Secondary hæmorrhage due to suppuration and necrosis of the kidney occurs. Temporary or persistent anuria is sometimes observed, and is due to previous disease or atrophy of the uninjured kidney

Discoloration of the skin at the external abdominal ring, scrotum, or labium may appear, after a fortnight or three weeks, as the result of blood tracking along the spermatic vein. Intraperitoneal effusion of blood and urine may be detected in the pouch of Douglas on rectal examination.

The possible **complications and sequelæ** are—(1) anuria, (2) intraperitoneal hæmorrhage, (3) pseudo-hydronephrosis, (4) retention of urine, (5) septic complications, (6) traumatic hydronephrosis, (7) movable kidney (8) traumatic nephritis.

Course and prognosis.—In favourable cases the urine clears in a few days, and the symptoms disappear in ten days. In severe cases the immediate dangers are shock and hæmorrhage, and the remote, septic complications and anuria. The later the onset and the less acute the progress of the septic process the better the prognosis. Prognosis is chiefly affected by hæmorrhage and by injury to other organs. Recovery takes place in 70 per cent. of uncomplicated cases.

Treatment.—Slight and moderately severe uncomplicated ruptures are treated by efficient strapping of the side and a covering broad bandage, by ice-bags over and under the loin, and by absolute rest in the recumbent position. The food should be fluid. Calcium lactate is given in doses of 10–15 gr. every four hours, for forty-eight hours, and morphia administered hypodermically Shock, if not profound, should not be too energetically treated, lest bleeding be encouraged. If there is retention the bladder should be emptied under the most rigid aseptic precautions. An evacuating cannula and bulb may be used to empty the bladder of clot; but if this measure is not quickly successful the bladder should be opened suprapubically the clots cleared out, and a large drain inserted.

Operation on the kidney may be required for—(1) immediate severe hæmorrhage, (2) delayed severe hæmorrhage, (3) suppuration of the injured kidney (4) septic peritonitis, (5) hydronephrosis or pyonephrosis. The kidney is exposed by an oblique lumbar incision, the clots are cleared away and a search made for the bleeding point. Tears of the kidney are closed

with catgut sutures, and extensive laceration and bruising by packing with strips of gauze. A distended renal pelvis should be incised, the clots turned out, and the pelvis packed with gauze. Detached portions and shreds of kidney tissue are removed, and primary nephrectomy may be necessary. Rectal and intravenous infusion of glucose solution (1 per cent.) should be given after the operation.

Suppuration should be treated by free incision and drainage, and laparotomy may be necessary for septic peritonitis. Persistent anuria is treated by nephrotomy and packing (see also p. 821).

Results.—The results have greatly improved in recent years with early aseptic operations. Operative interference in septic complications should not be too long delayed. In uncomplicated cases the death rate is 18·9 per cent. In cases treated expectantly the mortality is 21·1 per cent., in conservative operations, 11·7 per cent., and in nephrectomy 17·9 per cent. (Riese).

2. Injuries with External Wound

Wounds of the kidney are much less frequent in civil life than subcutaneous injuries. The intestine, spleen, liver or pleura may also be wounded. The blood escapes by the external wound, and, unless there is a long sinuous track, no accumulation takes place around the kidney. The kidney may prolapse from a large wound. Primary union is rare, prolonged suppuration common. Urinary fistulæ occur but seldom persist.

Symptoms.—There is external hæmorrhage, and urine escapes through the wound after a few days when the hæmorrhage is subsiding. Hæmorrhage from stab wounds may be severe and rapidly fatal. In bullet wounds the external hæmorrhage is seldom severe, but it may be intermittent. Pain is persistent, but does not radiate along the ureter. Occasionally flatus from laceration of the intestine may be passed from the external wound. Septic complications occur on the fourth or fifth day and portions of clothing and sloughs may be discharged.

Prognosis.—This is comparatively good, and operation is frequently successful. Wounds of other organs increase the gravity of the prognosis. The mortality of incised wounds is as low as 15 per cent. (Albarran), but bullet wounds have a high mortality—63 per cent. (Küster).

Treatment.—If the external hæmorrhage is moderate and diminishing, it will be sufficient to clean and drain the wound. A careful watch must be kept for recurrent hæmorrhage and septic complications. If a foreign body has lodged, or hæmorrhage is severe, the track should be freely enlarged, and the kidney exposed and examined. In complicated cases exploratory laparotomy is necessary.

ANEURYSM OF THE RENAL ARTERY

Only 25 cases of this rare condition were found in the literature by Skillern in 1906. It is most often caused by trauma in active men, but may occur spontaneously in either sex in association with endocarditis or arterial degeneration. The size varies from that of a hazel nut to a large swelling occupying the whole loin and extending inwards as far as the middle line. When the aneurysm is large and especially when a false aneurysm has formed, the kidney tissue is extensively destroyed by pressure, the colon displaced forwards and inwards, and the liver or spleen pushed upwards.

Clinical features.—A small aneurysm produces no symptoms; a large one forms a swelling in the kidney region. The tumour usually

appears some days or weeks after an injury but two or even fourteen years may elapse. The swelling is smooth, slightly movable or fixed, and does not move with respiration; it is rarely painful or tender Hæmaturia is early and usually precedes the discovery of the swelling. Profuse and rapidly fatal hæmorrhage follows rupture into the renal pelvis or peritoneal cavity Pulsation has rarely been observed. Morris found a loud systolic bruit over the tumour in one case.

Treatment.—The condition will usually be diagnosed during an exploratory laparotomy A small opening in the sac should be sufficient to permit recognition of the laminated character of the contents. If severe hæmorrhage takes place the wound should be plugged with gauze, the abdomen opened in the semilunar line, and the pedicle of the kidney exposed and ligatured. The aneurysmal sac and kidney are then removed. In three cases operation has been successful.

PERINEPHRITIS

Chronic perinephritis leads to the formation around the kidney of a layer of inflammatory tissue, either fibro-sclerotic or fibro-lipomatous, and tough adhesions are formed with surrounding structures.

Some form of chronic inflammatory disease of the kidney is invariably present, such as pyelonephritis, pyonephrosis, calculus, or tuberculosis.

In the sclerotic form the fatty capsule of the kidney is replaced by a dense layer of fibrous tissue, sometimes of cartilaginous hardness. In the more common fibro-lipomatous form the delicate perirenal fat is replaced by coarse nodular fat with a tough fibrous stroma. The fibro-lipomatous mass may develop principally around the pelvis or at one pole.

The symptoms and treatment are merged in those of the underlying renal disease. The movements of the kidney are not appreciably limited.

PERINEPHRITIC ABSCESS

A perinephritic abscess may occur at any age, and may be primary or secondary Men are more frequently affected than women, and the right side more often than the left.

Etiology.—The primary form may follow injury More frequently it develops during the course of typhoid, scarlet fever measles or pneumonia, tonsillitis, carbuncle, recurrent boils, or even eczema. The secondary form complicates suppuration in some neighbouring organ, such as the kidney (25 per cent.) liver gall bladder appendix pelvic organs, or vertebræ Tuberculous perinephritic abscess is especially found in tuberculous disease of the vertebræ, and is very rarely secondary to tuberculosis of the kidney Pus from an empyema or an abscess of the lung may track through the costo-lumbar hiatus of the diaphragm and form a perinephritic abscess.

Bacteriology —The bacteria found, in their order of frequency

are staphylococcus streptococcus, B coli The gonococcus and pneumococcus are rare.

Pathology.—Perinephritic abscess is frequently due to rupture or extension outwards of a cortical abscess or infarct caused by a blood borne staphylococcal infection. The collection is usually unilocular but occasionally multilocular It is situated outside the fibrous capsule, and may be inside or outside the perinephric fascia. In the former case the pus will spread along the ureter into the bony pelvis, while in the latter it will appear on the surface of the body over the iliac crest or pass into the iliac fossa Four varieties are distinguished according to situation

1 Above the kidney or subphrenic, which is frequently connected with intrathoracic suppuration. The kidney is pushed down and may be felt below the mass.

2. Below the kidney which tends to pass downwards to the iliac fossa and may rupture into and pass along inside the psoas sheath and appear in Scarpa s triangle, or pass into the pelvis and escape at the sciatic notch.

3 In front of the kidney limited by peritoneum this is rare. It may rupture into the peritoneal cavity bowel, bladder or vagina

4 Behind the kidney a much more common variety which may pass through the lumbar muscles at the triangle of Petit.

Symptoms.—When perinephritic abscess complicates some other disease the symptoms are superadded to those of the primary disease When the perinephritic suppuration is primary the onset is usually insidious and the pain slight and insignificant. The general condition of the patient is bad, and there is high remittent fever though in rare cases the temperature is not raised. Occasionally the onset is sudden and heralded by a rigor Pain and tenderness over the kidney become marked. The pain may radiate to the shoulder or arm, but more frequently passes downwards to the scrotum or labium. It is increased by movement, respiration, coughing and sneezing. The abdominal muscles are rigid on the diseased side.

The corresponding thigh is stiff and becomes flexed and rotated slightly outwards. Extension is restricted, but flexion unlimited. There may be transient paralysis of the lower limb.

The whole loin bulges outwards and backwards. The anterior swelling is less than in kidney tumours. The tumour does not move on respiration, and there is little movement on palpation. In suprarenal perinephritic abscess there may be jaundice, ascites, and œdema of the legs, and persistent vomiting when the right side is affected. In infrarenal abscess there are symptoms of involvement of the psoas muscle, neuralgic pain in the groin and genitals, retraction of the testicle and constipation. Œdema in the loin may be present,

especially if the abscess be behind the kidney When the kidney is diseased there is pyuria, and bacteria are present in the urine, but a cortical infection of the kidney may be present and the urine remain sterile. In acute cases, pus forms in from ten to twelve days in subacute, in three or four weeks.

In tuberculous cases acute symptoms are absent, and pain and tenderness are slight.

If no operation is performed, either the patient dies of septicæmia or the abscess ruptures on the surface or into the pleura, bronchi colon, peritoneum, bladder or vagina.

Diagnosis.—The condition may be mistaken for typhoid fever in the early stage and for hip-joint disease or pyonephrosis at a later period When only fever and general symptoms are present, leucocytosis will show that suppuration is going on in the body a negative Widal reaction will exclude typhoid fever and examination of the blood will eliminate malaria. Against hip-joint disease there are freedom of flexion and rotation of the thigh and absence of local tenderness.

A pyonephrosis is regular and well defined it moves with respiration, projects forwards rather than laterally or backwards, and does not cause œdema of the skin. A pyonephrosis may be present and be concealed by a perinephritic abscess.

Prognosis.—Good results are obtained by prompt operation in primary cases. The longer the operation is delayed the worse is the prognosis In secondary perinephritic abscess the prognosis depends upon the original cause.

Treatment.—Early operation is the only successful method. The kidney is exposed by an oblique incision, and all pockets of the abscess drained, care being taken not to overlook iliac and subphrenic collections of pus.

If the kidney is the seat of abscess, pyelonephritis, or pyonephrosis, it should be freely incised and drained, but nephrectomy will probably be necessary When the abscess has originated in an empyema, this should be drained.

In old-standing cases with persistent sinuses a diseased kidney or an imperfectly drained empyema may necessitate nephrectomy resection of portions of ribs or other secondary operations.

The mortality of cases treated without operation is 80 per cent and of operated cases 7 1 per cent. (Watson)

SURGICAL INFLAMMATIONS OF THE KIDNEY AND PELVIS

These may be bacterial or non bacterial, and caused by mechanical means or by the excretion of irritants.

Aseptic Pyelonephritis

This form of pyelonephritis occurs under the following conditions —

1. *In acute retention of urine.*—Guyon and Albarran have shown that in retention of urine there may be acute congestion of both kidneys progressing to interstitial and intratubular hæmorrhages with desquamation of tubular epithelium. The quantities of urine and of renal salts are reduced, and blood, renal cells, and epithelial and blood casts are present. Polyuria follows relief of the retention, and the urine contains casts for several days. If the obstruction is completely relieved and sepsis is absent, the symptoms entirely disappear

2. *Due to excretion of irritants.*—A mild catarrhal pyelonephritis may be induced by the elimination of certain balsamics, such as sandalwood copaiba and turpentine.

3. *In chronic urinary obstruction.*—In this condition the ureters and renal pelvis become dilated and thickened, and chronic interstitial nephritis develops. Both kidneys are affected, but usually unequally

The **symptoms** are slight and easily overlooked. Dull aching pain in one or both kidneys, constant thirst, especially at night, and anorexia are associated with frontal headache and appreciable loss of weight. The temperature is slightly subnormal, and the tongue dry There are no cardiac or vascular changes the kidneys cannot be felt and are not tender

The urine is pale and clear free from tube casts and cells, and contains a low percentage of urea and other urinary constituents. The polyuria amounts to 80–100 ounces per diem, and is more marked at night.

Infections of the Kidney and Pelvis

Bacteriology.—The B coli is the commonest cause of renal infection next in frequency come the staphylococci (especially aureus) streptococci, Proteus vulgaris (Hauser) and B pyocyaneus the pneumococcus and the gonococcus are rare. The B coli is usually found in pure culture but sometimes is mixed with proteus, staphylococcus, or streptococcus. Anaerobic bacteria are occasionally found especially in pyonephrosis. The staphylococcus and Proteus vulgaris cause ammoniacal decomposition in the rare pure streptococcal and in the common B coli infections the urine remains acid

Pyelonephritis occurs in *two forms*—(*a*) primary or "hæmatogenous pyelonephritis, appearing without previous urinary disease, and believed to be caused by blood borne bacteria and (*b*) secondary or "ascending" pyelonephritis, which follows infection of the lower urinary tract.

(*a*) **Primary or hæmatogenous pyelonephritis.**—This disease occurs in infants, children, and adults. In infants and

young children it is comparatively common and affects the pelvis more severely than the kidney In adults it exhibits a predilection for the right kidney for the most active period of life, and for the female sex, especially during pregnancy (*see* p. 817)

Etiology —Usually there is a history of chronic constipation, and sometimes of recent diarrhœa in such cases the colon is probably the chief source of the bacteria. Tonsillitis, boils, or carbuncles may be the primary focus while the renal infection occasionally complicates influenza or typhoid fever

(*b*) **Secondary or ascending pyelonephritis.**—This disease results from extension of infection from the lower urinary organs. It is the last phase of many chronic vesical and urethral diseases, and sometimes follows surgical interference with the bladder or urethra ('surgical kidney') Although at first often unilateral, later it is invariably bilateral affecting one side more than the other. As seen by the surgeon, the disease is bilateral in 83 per cent. of cases.

Etiology.—Bacteria are introduced into the bladder by faulty instrumentation, or rarely are carried from a previously infected urethra by a sterile instrument. The predisposing causes are urethral obstruction, prolonged cystitis, vesical new growths, operations on the bladder involving the ureteric orifice, and stone in the bladder or ureter

Pathology of infective pyelonephritis.—In the acute forms there may be extensive hæmorrhages in the renal substance, with irregular pale or yellowish purulent areas in the cortex and medulla. Sometimes small bosses on the surface correspond to the position of these areas. Microscopically definite abscesses are seen, with destruction of kidney tissue, and cloudy swelling of the secretory epithelium is a prominent feature There are patches of dense infiltration with leucocytes.

In the most *fulminating* types the kidney is plum-coloured, with dark cortex and paler pyramids, and is engorged with blood.

In the chronic varieties the abscesses may be still present, but there is always marked interstitial change, and at points collections of small round lymphocyte-like cells are seen. At places the tubules and glomeruli may be destroyed by the newly formed fibrous tissue. In very advanced cases the kidney may be much reduced in size, very tough, and firmly adherent to the surrounding tissues. It may contain small cysts.

Clinical features. (1) Acute hæmatogenous pyelonephritis.—The attack is often preceded by headache, lassitude, and anorexia, and by diarrhœa or by an exaggeration of habitual constipation. In 6 per cent. of cases there is a sudden desire to micturate, followed by great frequency and strangury lasting a few hours or a day or two.

In a *mild* case there is a rigor followed by rise of temperature to 101° or 102°, aching in one loin, and tenderness, without enlargement, of one kidney. The urine is abundant, pale, with low specific gravity and a stale-fish odour, and bacteriuria is present. The attack lasts ten or fourteen days.

In a *more severe* attack the temperature reaches 102° or 103°, the patient is prostrate, drowsy, perhaps delirious, and suffers general abdominal pain, and also backache, especially in one loin. The diseased kidney, which, as a rule, is palpably enlarged, is intensely tender, and the abdominal muscles on that side are rigid. The urine is scanty, acid (very rarely alkaline), and contains bacteria, pus-cells, blood-corpuscles, tube-casts, and epithelia from the renal pelvis and bladder. The leucocyte count is 16,000 to 20,000. B. coli has been found in the blood, especially in children.

After two or three weeks the acute symptoms may subside, but may repeatedly recur owing to exacerbations in the first kidney or to fresh infection of the second kidney.

The illness may last for months. Instead of pursuing a benign course, there may be repeated rigors, a high swinging temperature (106° to 107°), and death occurs in four or six weeks from the onset.

In the rare *fulminating* cases a severe rigor and rise of temperature to 104° or 106° is followed by drowsiness and coma. There are abdominal pain and rigidity, vomiting, and scantiness or complete suppression of urine.

(2) **Acute ascending pyelonephritis.**—During the course of some disease of the lower urinary organs, and usually as a sequel to instrumentation, there is a rigor with a rise of temperature to 103° or 104°. Drowsiness, apathy, and backache, more marked on one side, are frequently associated with nausea, vomiting, absolute constipation, and increasingly distressing hiccup. The tongue is dry, red, and glazed, and later becomes covered with brown or black fur ("parrot tongue"). The abdomen shows flatulent distension and rigidity, especially on one side. At first both kidneys are tender, but after twenty-four hours this is confined to one organ, which is enlarged. Polyuria has frequently been present beforehand, but now is replaced by partial or complete suppression. The temperature may remain at 102° or over, or may be high and swinging with recurring rigors. *Labial herpes is common.*

The symptoms increase in severity, muttering delirium supervenes, and the patient becomes comatose and dies. Uræmic dyspnœa and Cheyne-Stokes breathing may be present, but convulsions are extremely rare. In less severe cases the secretion of urine becomes re-established, the temperature falls, flatus is passed, and the symptoms subside.

Some cases are characterised by recurrent hæmorrhages

(3) **Chronic suppurative pyelonephritis.**—Chronic pyelonephritis may follow acute pyelonephritis, whether hæmatogenous or ascending or may be engrafted on a chronic aseptic pyelonephritis when fully developed it gives rise to "urinary septicæmia." The complexion is sallow, the skin dry and harsh, the mouth and throat dry the tongue dry and later glazed, red and cracked There are dyspepsia, nausea, frontal headache and constant drowsiness, with persistent loss of weight and appetite.

The urine is abundant (80–100 oz. per diem), pale neutral or faintly acid, of sp. gr about 1005, and hazy with pus or with flakes. Bacteria are plentiful, but bacteriuria only occasionally occurs. Nocturnal polyuria and vesical irritation are the chief subjects of complaint. In the ascending variety the symptoms of the primary lower disease are also present. Acute exacerbations are probable from time to time especially after surgical intervention.

Prognosis.—(1) In mild cases of **hæmatogenous** pyelonephritis the prognosis is good, but relapses may occur and in a large percentage of cases bacteriuria or slight chronic pyelonephritis persists. In acute cases the outlook is grave and operation is frequently necessary Fulminating cases frequently terminate fatally

(2) Many patients die during the acute attack of **ascending** pyelonephritis, and most of those who recover suffer from chronic pyelonephritis. Removal of the urinary obstruction will probably arrest the disease, but the kidneys are permanently damaged.

(3) **Chronic** pyelonephritis persists for years, and eventually destroys the kidney The dangers of secondary stone formation in the kidney and of ascending pyelonephritis in the other kidney are ever present.

Treatment. (1) **Acute hæmatogenous pyelonephritis.** (a) *Medicinal.*—Mild and early cases may be suitably treated by confinement to bed, and the application of cupping or of hot fomentations and turpentine stupes over the loins, combined with the administration of urinary antiseptics such as hexamine, hetraline, or helmitol, and the free use of diuretics such as theocin sodium acetate and Contrexéville water When the B coli is the infecting bacterium and the urine is acid, a course of alkalis (potassium citrate sodium bicarbonate) should be substituted for the antiseptic treatment. A smart purge, followed by small doses ($\frac{1}{10}$ to $\frac{1}{4}$ gr) of calomel, should be given.

(b) *Serum treatment*—The suitable antiserum, usually the antibacillus coli serum, may be hypodermically injected in daily doses of 25 c.c. for three days, accompanied by calcium lactate in 20-gr doses thrice daily by the mouth to prevent joint pains and serum rashes.

This treatment is only suitable for acute cases, and should be abandoned if not effectual in three days.

(c) *Vaccine treatment.*—Graduated doses of dead bacteria are injected from autogenous cultures, or from stock vaccine if time prevents the preparation of an autovaccine. Beginning with small doses of 2 or 5 millions repeated in four or five days, the dose rises rapidly to 10 15 20 25 30 millions, and so on to 100 150 and 200 These injections should be made once a week if any reaction occurs, the doses should be reduced and a longer interval allowed. This treatment is only suitable for chronic cases, or chronic cases with acute exacerbations where no complication such as growth or stone is present.

(d) *Operative treatment.*—Only nephrotomy and nephrectomy need be considered. I have collected 20 cases of nephrotomy with 7 deaths these include 5 personal cases, all of whom survived nephrotomy The after results of nephrotomy are unsatisfactory chronic pyelonephritis persists, and nephrectomy may be required later Nephrectomy gives the best results in acute cases : of 17 collected cases, all recovered.

(2) **Acute ascending pyelonephritis.**—(a) *Prophylactic measures* consist in rigid asepsis and the utmost gentleness in all urethral manipulations.

(b) *Non operative treatment* is conducted on the lines laid down for acute hæmatogenous pyelonephritis (above) Sweating may be induced by a hot pack or hot vapour bath, and by hypodermic injection of pilocarpine. Suppression of urine demands rectal or intravenous infusion of glucose solution (*see* Anuria, p 821)

(c) *Operative treatment.*—This is necessary if non-operative measures fail it aims at two objects—removal of urinary obstruction if present, and relief of congestion and drainage of the kidney Any unrelieved urinary obstruction first receives attention. Suprapubic cystotomy rapidly performed, and the insertion of a large tube, give the best drainage with the least shock. The obstruction can be more permanently treated later if the patient survive. For relief of the renal congestion and sepsis, the kidney should be freely incised along the convex border and a large rubber drain introduced into its pelvis another large drain is placed outside the kidney

Nephrectomy may become necessary in the hæmorrhagic type of pyelonephritis.

(3) **Chronic pyelonephritis.**—Prophylaxis consists in all measures directed against chronic obstruction and sepsis in the lower urinary organs.

When chronic pyelonephritis has become established operative interference with bladder or urethra must be undertaken with the

utmost caution. Suprapubic drainage should precede prostatectomy by a week or more, and external urethrotomy should be preferred to dilatation or internal urethrotomy for stricture. Urinary antiseptics and diuretics should be freely administered.

If the second kidney is proved to be healthy by examination of its urine, nephrectomy may be performed. Circumstances, however rarely render this possible.

In chronic hæmatogenous pyelonephritis operation may be necessary for recurrent exacerbations, persistent cystitis, secondary calculus, or rarely anuria.

Vaccine treatment, at any rate in cases complicated by stone, growth or obstruction, has not given satisfactory results.

PYELITIS

The intimate relation between the kidney and the renal pelvis precludes absolute limitation of severe inflammation to one or other, but there are cases of mild subacute or chronic inflammation where the pelvis is affected and the kidney but slightly involved.

Etiology.—Mid-adult life is most frequently affected. The infection may be hæmatogenous, or may ascend from the lower urinary organs it is most frequently due to the B coli or some allied bacillus. A calculus may be present in the renal pelvis

Pathology.—The mucous membrane is hyperæmic, and in severe forms is thickened, velvety and may show petechiæ and superficial ulceration. In old-standing pyelitis the wall is thick and leathery the mucous membrane is opaque and may show small colloid filled cysts (pyelitis cystica) or tiny sago-grain lymph follicles (pyelitis granulosa) The condition may be unilateral or bilateral.

Symptoms.—These are usually insignificant in non-calculous pyelitis. The temperature may rise to 100° F at night, and there is slight constant renal aching with occasionally some tenderness on pressure. The kidney is not enlarged.

Polyuria is present especially at night. The urine is pale, opalescent, acid, of low specific gravity (1008) and usually odourless, but occasionally it has a fishy smell. On standing, it deposits a flat creamy layer of pus which moves heavily on tilting the glass. Microscopically bacteria and tailed and overlapping epithelial cells are seen, but no tube-casts.

Cystoscopically the ureteric efflux is copious, frequently repeated, and cloudy The lips of the ureteric orifice are reddened and thick and surrounded by a halo of congestion. Ureteral catheterization demonstrates the characteristic urine, which may be alkaline on the diseased side.

The symptoms of pyelitis may be obscured by those of cystitis.

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The symptoms of pyelitis may be obscured by those of cystitis.

Diagnosis.—In cystitis the diagnosis depends upon the presence of renal aching, the observation of a cloudy efflux and of changes in the ureteric orifice and the examination of a specimen drawn by the ureteric catheter It is incomplete until calculus has been found or excluded.

Treatment.—Any cause of local irritation such as stone should be removed, and diseases of the lower urinary tract such as stricture and enlarged prostate treated.

Urinary antiseptics (hexamine, hetraline, helmitol) and diuretic waters (Contrexéville, Evian, Vittel) should be given. Where B. coli is the infecting bacterium and the urine is acid, a course of alkaline treatment (potassium citrate) may be substituted for the antiseptics.

Vaccine treatment should be tried in chronic cases (*see* Pyelonephritis, p 844)

Lavage of the renal pelvis with solutions of argyrol, collosol argentum, and other silver preparations may be made through the ureteric catheter This is one of the most effective methods of treatment but it is only justifiable in expert hands.

In severe cases where all methods of treatment have failed the kidney should be exposed the pelvis opened, drained by a rubber tube and washed with nitrate of silver solution.

Pyelitis of Infancy and Childhood

Many cases are met with in infants and older children, especially girls. There is frequently a history of constipation, and sometimes of diarrhœa.

The **symptoms** begin suddenly with a rigor followed by rise of temperature (104 to 106 F) which becomes remittent in type. The child is pale, restless, and distressed. Anorexia is marked, and delirium squinting, and vomiting follow Emaciation is slow There may be repeated chills.

The local symptoms are insignificant. Attacks of screaming due to colic occur and there may be tenderness on palpation of the kidney There is occasionally pain during and increased frequency of micturition. Yellowish staining of the diapers may be the first sign.

The urine is strongly acid and contains pus, some albumin, red blood-corpuscles, epithelial cells from the renal pelvis and sometimes from the bladder and occasionally hyaline and finely granular casts. Bacteria are present, usually the B coli, occasionally the staphylococcus or the streptococcus.

Diagnosis.—This depends upon the examination of the urine. Pyrexia with extreme distress and rigors without other symptoms in a child under 2 years where malaria can be excluded are usually due to pyelitis (J Thomson)

The condition has been mistaken for malaria, typhoid and general tuberculosis.

Prognosis.—Rapid improvement under treatment and recovery is the rule, but a fatal termination occasionally occurs.

Treatment.—Citrate of potash is given in doses of 24 gr., or in severe cases 36–48 gr. per day in infusion of digitalis, and continued till the danger of relapse is past. Hexamine and salol may be given when the temperature has fallen if bacilluria is still present.

Operative measures are rarely necessary. Nephrotomy may be performed if the child is steadily losing ground.

Pyelitis (Pyelonephritis) of Pregnancy

Pyelonephritis not infrequently develops during pregnancy when it has special characteristics.

Pathology.—The bacteriology is similar to that of other renal infections. The right kidney is nearly always attacked (93 per cent.), and the disease most frequently appears about the fourth month of pregnancy. It has been ascribed to compression of the ureter by the gravid uterus, but at this early stage the uterus is hardly likely to cause pressure. The infection may have followed the passage of a catheter (ascending) or may be hæmatogenous.

Symptoms.—There is a rigor and the temperature rises, with severe paroxysmal unilateral renal pain and frequent painful micturition. The urine contains pus and bacteria, but may be almost clear even in severe cases. The general condition usually remains good, although the temperature is high and swinging. In a few cases the disease is bilateral, and there are rapid emaciation, drowsiness, burning thirst, dry tongue, and other signs of uræmia. The abdomen is rigid on one side and the kidney tender and enlarged.

Diagnosis.—This depends on the position of the pain and tenderness, and on the examination of the urine. A mistaken diagnosis of appendicitis may easily be made.

Prognosis.—Premature labour occurs in 25 per cent. of cases, and the child dies in one-third of these (Leguen). When the attack occurs early in pregnancy the puerperium is usually apyretic, but if the onset is late there is usually fever during the puerperium. If the pyelitis is late and the pregnancy goes on to full term the child is healthy and well nourished.

Bacilluria and slight pyelonephritis frequently persist, and there are exacerbations during succeeding pregnancies.

Treatment.—Prophylaxis consists in careful asepsis in catheterization, and in the treatment of constipation during pregnancy.

If bacilluria or chronic pyelonephritis is present, this should be energetically treated. The production of abortion or the induction

of premature labour is seldom necessary but may be called for in a severe case. If the infection is due to B coli, alkaline treatment should first be tried. Potassium citrate is given in increasing doses until the urine is neutral or slightly alkaline and this reaction is maintained until the temperature has fallen. In a few cases the alkaline treatment fails and urinary antiseptics should be given. Vaccine treatment should be tried if the temperature persists or recurs. Nephrotomy has yielded good results in severe cases. In acute bilateral pyelonephritis, premature labour should be induced.

Nephrectomy may be necessary in grave unilateral pyelonephritis. It is well borne in the early months of pregnancy but less so after the fifth month. The mortality is 9 5 per cent. (Cova).

PYONEPHROSIS

Pyonephrosis is distension of the kidney and its pelvis with pus or purulent urine. There are two forms—(1) pyonephrosis secondary to hydronephrosis, or uro-pyonephrosis (2) pyonephrosis from acute pyelonephritis.

Etiology.—The etiology of uro-pyonephrosis is similar to that of hydronephrosis. The condition is unilateral, most frequent on the right side and in women. The obstruction is usually situated high in the ureter and is due to stone, stricture or folds or valves of the upper ureter The superadded infection is either ascending, from recent cystitis, or hæmatogenous.

Pyonephrosis developing in acute pyelonephritis may complicate chronic disease of the lower urinary organs, and is more frequent in men.

The outlet of the renal pelvis becomes occluded from inflammatory swelling and the kidney is rapidly expanded and destroyed by the pressure of the retained urine and by inflammation.

The bacteria are those of other renal infections. A pyonephrosis is "open" when the obstruction is incomplete, and "closed" when it is complete.

Pathology.—When the infection ascends, the pelvis is greatly dilated. In other cases the kidney is transformed into a large multilocular sac, and the pelvis is small and hidden. The kidney is frequently firmly adherent to its surroundings, and may be surrounded by a thick fibro-fatty layer. The interior is lined with smooth, tough thick membrane, and the wall contains sclerosed and infiltrated renal parenchyma.

Partial pyonephrosis may occur from blocking of one section of a dichotomous pelvis or of one or several calyces by stone. In uro-pyonephrosis the contents are urine with a varying admixture of pus. In pyonephrosis there is pus with little urine. Primary or secondary

calculi may be present. (Fig 541) The ureter is dilated thickened and tortuous when the obstruction is low down.

Clinical features.—The symptoms of cystitis may obscure those of pyonephrosis. In the ascending variety there are usually symptoms of pyelonephritis. Infection in a hydronephrosis is shown by a rigor and a rise in temperature.

The symptoms of pyonephrosis are pain, tenderness, swelling, and pyuria. The pain is constant, heavy and boring in character and tenderness is pronounced at first. There may be severe colic, and also flexion of the thigh. The tumour has the characteristics of a renal tumour, and is large firm tender smooth, and non fluctuating.

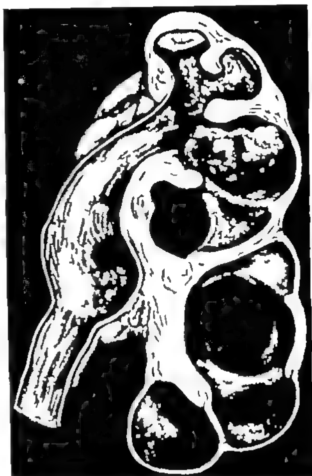


Fig. 541 —Calculous pyonephrosis with dilatation of ureter

Pyuria is the cardinal symptom. It forms an abundant thick, heavy deposit, subject to pronounced variations in quantity There are recurrent attacks of complete retention of pus during which the urine becomes clear the tumour larger more tender painful and tense and the temperature rises.

On cystoscopy cystitis is usually found, and the orifice of the ureter is seen to be open, round, and immobile and to have thick and in some instances œdematous or ulcerated margins.

In a closed pyonephrosis an efflux is absent in an open pyonephrosis it consists of semi-solid pus watery pus, or purulent urine

Diagnosis.—The diagnosis of a closed pyonephrosis depends upon the history of pyuria, and the presence of a renal tumour with symptoms of septic absorption.

If pyuria is present, this and cystoscopy will lead to a diagnosis. Large intermittent discharges of pus in the urine are found in three conditions, viz. pyonephrosis, a suppurating vesical diverticulum, and a purulent collection communicating with the ureter or bladder. The cystoscope will distinguish a diverticulum of the bladder and pyonephrosis has a characteristic tumour.

In pyelonephritis without retention there is a small quantity of pus in the urine, and catheterization of the ureter reveals no obstruction.

In tuberculous pyonephrosis there are tubercle bacilli in the urine, and often tuberculous lesions elsewhere; the tuberculous ureter is thick and hard, and the general tests for tuberculosis are positive.

Treatment.—1. *Plastic operations* are referred to under Hydronephrosis (p. 857). The infection in pyonephrosis makes failure of any plastic operation practically certain, and such operations are *usually rendered worthless by the extensive functional destruction* of the kidney.

2. *Nephrotomy* may be confined to incision and drainage of the kidney, or an attempt may be made to re-establish the lumen of the ureter. The pyonephrotic sac is opened through an oblique lumbar incision, the contents evacuated, septa broken down, search made for interstitial abscesses and for stone, and a large tube placed in the nephrotomy wound and another outside the kidney. This operation is rapid and devoid of shock, and is suitable for the worst cases. The mortality is 17–23 per cent. After the operation the general health and the function of the second kidney show great improvement. In 27 per cent. of cases (Küster) the wound closes, the sac shrinks, and the patient is cured.

A fistula remains in from 45·6 to 50 per cent. of the cases (Küster). Attempts to obviate it have been made by passing sounds from above downwards (Bazy) or from the bladder upwards (Albarran) and by tying a catheter in the ureter. A fistula may be cured by removal of its fibrous wall, the opening up of the sac, removal of calculi and free drainage.

Should these fail, a urine-collecting apparatus may be fitted or nephrectomy may be performed.

3. *Nephrectomy.*—Secondary nephrectomy is indicated where septicæmia persists or exhaustion is following the prolonged suppuration. The mortality is 5·9 per cent., but to this must be added the mortality of nephrotomy (23·3 per cent.) making the total mortality 29·2 per cent.

Primary nephrectomy may be partial in rare cases. Total nephrectomy is performed by the lumbar route and the best method is subcapsular nephrectomy the mortality of which is 17 per cent. (Küster) The chief danger is the inadequacy of the second kidney owing to disease—in 40 per cent. of cases (Legueu) Nephrectomy should not be performed until the condition of the second kidney has been thoroughly investigated.

RENAL AND PERIRENAL FISTULÆ

Of these fistulæ the great majority follow an operation a few appear spontaneously or result from injury

1 **Perirenal fistulæ unconnected with the urinary organs.**—Perirenal fistulæ unconnected with the urinary organs may take origin in an empyema appendicitis or other purulent collection. The original seat of the suppuration is shown by the history of the case or the presence of scars. Much information can be obtained by radiography after injection of the fistulæ with a bismuth emulsion.

Examination of the urine cystoscopy and catheterisation of the ureter on the fistulous side demonstrate that there is no urinary infection and that the ureter on this side is patent and the kidney active

The injection of the fistula with opaque fluid (sodium bromide, 20 per cent.) combined with pyelography will give accurate information of the direction of the fistulous tract and its relation to the kidney

2 **Spontaneous renal fistulæ.**—These are rare. A fistula may follow wounds of the kidney but is rarely permanent Pyonephrosis may rupture into the perinephric tissue and burrow to the surface of the body or open into the pleural cavity a bronchus, the stomach, duodenum or elsewhere Calculi may be discharged on the surface from a spontaneous fistula.

The discharge is purulent or uropurulent. Diagnosis is usually difficult To symptoms of pyonephrosis there are superadded those of rupture of a large abscess into a bronchus or elsewhere The escape of pus is usually intermittent

3. **Postoperative renal fistulæ.**—There is usually a single fistula opening at the posterior part of the operation scar but in tuberculous disease several intercommunicating fistulæ may be present The discharge may be pus, pus and urine or pure urine The fistulous track is narrow and usually straight The walls are thick fibrous and rigid The factors which cause a permanent fistula may be obstruction of the ureter or pelvis tuberculous infection of the track, a thick, hard, unyielding track wall or kidney or calculi or concretions in the lumen of the fistula

A fistula after nephrectomy may be due to necrotic portions of

the kidney being left in the pedicle to an infected pedicle ligature, or to pyogenetic or tuberculous infection of the wound.

Diagnosis.—Usually the cause of the fistula and the condition of the kidney are well known, but it may be uncertain if the fistula is urinary or not The discharge should be examined for urea After an intramuscular injection of methylene blue a urinary discharge will be tinged with blue The presence of stricture of the ureter and the quantity of urine that escapes down the ureter are ascertained by ureteral catheterization.

Treatment.—In some cases nephrostomy has been performed with the view of producing a permanent fistula. A modification of Hamilton Irving's suprapubic drainage apparatus should be fitted to receive the urine from the fistula. In postoperative purulent non urinary fistulæ the track should be dissected out, and all side tracks and pockets opened up and drained.

In urinary fistulæ, when the ureter is patent, drainage by a ureteric catheter *en demeure* has been recommended.

Injection of the fistula with a bismuth paste should be avoided, as plugs of paste may lodge in the kidney and obstruct the pelvic outlet. If the ureter is impassable and the kidney retains a considerable part of its function a plastic operation on the renal pelvis is necessary If the functional value of the kidney is low and the second kidney healthy nephrectomy should be performed.

SURGICAL TREATMENT OF NON-SUPPURATIVE NEPHRITIS

Acute nephritis.—In 1896 Reginald Harrison recommended incision of the renal capsule and puncture of the kidney for acute nephritis when associated with delayed convalescence, with suppression, or with cardiac and circulatory complications. Others have recommended nephrotomy with the same object.

Chronic Bright's disease.—1. Edebohls, Pousson, Casper, and others have treated *acute exacerbations* of chronic Bright's disease by operation when medical treatment has failed. Cases with advanced cardiovascular and pulmonary complications are unsuitable. Decapsulation and nephrotomy have been recommended. Except in the rare cases of proved unilateral disease, decapsulation is rapidly performed on both sides. The immediate mortality is 25 per cent partly due to the patients being moribund when the operation was performed. Some cures have been claimed, but improvement is usually temporary

2. In 1901 Edebohls suggested decapsulation for *chronic* Bright's disease, in the belief that thus a collateral anastomosis would be established and provide a free flow of blood through the kidney; he hoped to cause absorption of the interstitial fibrous tissue, and, by removal of the pressure upon the tubules, obtain regeneration of the renal epithelium. According to Edebohls, experiments show that, although the fibrous capsule invariably re-forms in a few weeks, the new capsule is composed of loose connective tissue which does not compress the kidney A parietal anastomosis has actually been observed, which was not strangled by contraction of the new capsule. The

kidney has also been transplanted into the peritoneal cavity and formed adhesions with the serous membrane or the omentum.

Although the course of the disease is generally uninfluenced, improvement is undoubted in some, and a cure has been claimed in a few cases. The operative mortality is 5 per cent.

HYDRONEPHROSIS

Hydronephrosis is chronic aseptic retention of urine in the kidney and renal pelvis due to ureteral or urethral obstruction.

Etiology.—Hydronephrosis is slightly more frequent in the female sex and on the right side It may be bilateral, especially when the obstruction is urethral

Ureteral obstruction may be caused by—(*a*) changes in the wall of the ureter (valves, folds, strictures) (*b*) obstruction of the lumen by calculi, tumours, foreign bodies blood-clot (*c*) pressure from without by tumours, fibrous bands (Fig 542) purulent collections, an aberrant renal vessel (Fig 543) (*d*) kinking of the ureter from undue mobility of the kidney (*e*) torsion of the ureter

Urethral obstruction may be caused by a congenital fold or diaphragm, or obliteration, or more frequently by stricture and enlarged prostate



Fig. 542.—Hydronephrosis due to bands of adhesion between ureter and renal pelvis.

Congenital hydronephrosis occurs before or soon after birth, and when unilateral may be due to valves or folds in or stenosis of the duct or to bending or kinking of a ureter misplaced in the bladder urethra, ejaculatory duct, seminal vesicle, vas deferens or vagina. More frequently congenital hydronephrosis is bilateral, and is due to urethral obstruction caused by a septum or imperforate portion, a cyst torsion of the penis, or phimosis. In some cases no obstruction can be found but the bladder ureters and kidneys are greatly dilated. In these cases there may be dilatation of the colon, and

the condition is probably due to changes in the sympathetic nervous system.

Pathology.—Hydronephrosis is said to be due to the persistence of folds of the mucosa and muscle found in the fœtal ureter and to twisting that occurs during development from the Wolffian duct.

Hydronephrosis due to abnormal vessels passing to the lower pole in front of or behind the ureter may cause obstruction by pressure



Fig. 543.—Hydronephrosis due to aberrant renal vessels (operation view) aneurysm needle under normal ureter

upon that duct. The obstruction is due to the band of fibrous tissue in which the vessels lie, rather than to the vessels. A congenital narrowing of the ureter may be present at the level of the abnormal vessels or above this level.

Hydronephrosis due to movable kidney is intermittent, and is the result of kinking of the ureter It is also held that the mobility may be consequent upon the increased size of the kidney already hydronephrotic.

Adhesions between the colon and the renal pelvis resulting from chronic constipation may be the cause of hydronephrosis.

When a tense hydronephrosis is found soon after an injury it has usually preceded the injury Late traumatic hydronephrosis results from stricture caused by injury to the ureter

In hydronephrosis due to calculus the stone may lie at the outlet of the pelvis or at the lower end of the ureter Stenosis of the ureter on the vesical side of the stone is frequently present.

A hydronephrosis is "closed" when the obstruction has become complete and "open" when urine escapes. In an open hydronephrosis there are attacks of retention due to temporary complete closure of the outlet.

Pathological anatomy—In the early stage the normal capacity of the renal pelvis (30–60 minims) is increased to 1 oz. or more. The pelvis is sac-like and the kidney hollowed, but the organ is not enlarged. The calyces become dilated, and the pyramids flattened and then hollowed. In the fully developed hydronephrosis the sac is formed from either the pelvis or the kidney When the pelvis is chiefly affected it forms a large globular sac on which the hollow kidney is set as a cap. When the kidney alone is distended the surface shows rounded bosses corresponding to the hydronephrotic pockets the pelvis is small and hidden.



Fig. 544—Hydronephrosis (pelvic type) due to stenosis of uretero-pelvic junction.

The interior of the hydronephrosis shows a single large cyst with pockets (pelvic type) (Fig. 544), or a small central cavity with numerous rounded chambers leading from it (renal type) The lining membrane is smooth, opaque, and white. If the obstruction is situated at the lower end of the ureter this tube is thickened dilated, and tortuous.

A partial hydronephrosis may be formed by the blocking of one segment of a double pelvis or the malformation of a calyx.

Even in advanced cases there is a considerable amount of sclerosed kidney tissue present in the wall of the sac. The contents consist of urine with a specific gravity of 1005 or less. The fluid may become mixed with blood and form a hæmatonephrosis.

Symptoms.—In the early stage the kidney is not palpably enlarged, and either there are no symptoms or there is aching pain in the costo-muscular angle with persistent polyuria. Later, a rounded tumour moving with respiration and presenting the characters of a renal tumour (see p 818) is found in the loin and may fill a large part of one side of the abdomen it is not tender. The tumour may be constant in size and the urine normal in quantity or there may be "intermittent hydronephrosis in which the tumour for considerable periods completely disappears At varying intervals—often after exertion or the drinking of a diuretic fluid—there are attacks of retention of urine in the sac, accompanied by severe pain, diminution in quantity of urine passed and sometimes complete suppression. At the same time the tumour is large, tense and tender After some hours or days a large quantity of urine is passed, the pain subsides, and the tumour disappears.

On cystoscopy there may be in the early stage increased frequency of ureteric contractions from polyuria, and in the later stage diminished frequency from the reduction in quantity of urine. When the block is complete there may be an occasional gaping at the ureteric orifice and when the muscular power of the pelvis and ureter are completely destroyed the orifice is still.

A ureteric catheter is arrested at some part of the ureter or uretero-pelvic junction, where the obstruction is situated. It usually passes after gentle manipulation and a rapid flow of urine follows.

Diagnosis.—The symptoms may lead to a diagnosis, and the X rays may show the presence of a stone. Frequently the diagnosis is uncertain in the early stages, and commencing dilatation can only be ascertained by one of the following methods

1 *Estimation of the capacity of the renal pelvis* (Kelly) by passage of a ureteric catheter and injection of a known quantity of fluid after removal of the pelvic contents. A capacity of 30–40 c.c. shows a moderate degree of hydronephrosis. When dilatation is more advanced, several ounces of urine may be withdrawn by the suction of a syringe In injecting fluid after emptying the pelvis the sensation of discomfort or pain in the kidney region is taken as the guide that the pelvis is full

2. *Pyelography* (Voelcker and Lichtenberg).—The pelvis of the kidney is emptied by ureteral catheter and a warm solution of sodium bromide (20 per cent) is slowly run in. A shadow showing the contour of the renal pelvis and calyces is obtained (see p 881)

Prognosis.—If sepsis is superadded a pyonephrosis results, and the prognosis is grave. Bilateral hydronephrosis is not incompatible with an active life, but eventually leads to suppression of urine.

Treatment.—Congenital hydronephrosis is rarely operable bilateral nephrostomy may be performed if both kidneys are affected but the infants invariably die.

In cases of urethral obstruction with hydronephrosis, operation for the relief of the obstruction should be undertaken. No direct operative treatment of the hydronephrosis will be necessary In these cases the dilatation of the kidney is moderate in degree.

In cases of movable kidney early nephropexy should be performed. In advanced cases the uretero-pelvic junction should be examined both outside and within the pelvis for adhesions, narrowing, and valves. When calculus is present it should be removed and the lumen of the ureter examined for stenosis. When an aberrant vessel is present, but not closely related to the point of obstruction, it need only be divided if it interferes with the plastic operation for the relief of the obstruction. If the vessel is the cause of the obstruction, it should be divided between two ligatures and the lumen of the ureter examined for stenosis.

Numerous operations are performed for congenital and acquired malformations of the ureter and dilatation of the renal pelvis, such as pyeloplication (Israel) orthopædic resection by removing the part of the pelvis and kidney below the level of the outlet (Albarran) resection of a large triangular flap of the pelvis (Thomson Walker), anastomosis of the ureter or pyeloureteral anastomosis, which may be lateral implantation of the cut ureter (ureteropyeloneostomy) or direct anastomosis of a hydronephrotic sac with the bladder (nephrocystoanastomosis) Finally there are plastic operations on strictures and valves, such as splitting of a valve and ureteropyeloplasty Nephrostomy i.e. the incision and permanent drainage of the sac, is sometimes performed.

Primary nephrectomy is indicated when the sac is very large and its wall thin and fibroid and when sepsis has been superadded, but only in cases where it has been proved that a second kidney is present and efficient. Secondary nephrectomy is required when conservative operations have failed.

TUMOURS OF THE KIDNEY

Benign Growths

Benign growths form less than 7 per cent. of renal growths. Adenoma is met with as a single, rarely multiple, cherry-sized subcapsular tumour of greyish white or pink colour and with a well-defined fibrous capsule. It usually occurs in kidneys the seat of chronic interstitial nephritis.

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The microscopical structure may be acini lined with cylindrical epithelium, and containing papillary formations (papillary adenoma) or solid or hollow masses of cylindrical epithelium (tubular adenoma). Lipoma is a small (very rarely large) single or multiple subcapsular tumour. Fibroma forms fibrous nodules in the cortex or medulla. Leiomyoma is rare, and originates in the smooth muscle of the capsule. Small benign tumours are found post mortem; large growths are indistinguishable clinically from malignant growths.

Malignant Growths

The varieties met with are—(1) carcinoma (2) sarcoma, (3) hypernephroma, (4) mixed tumours of embryonic type.

The great majority of renal growths are found under the age of 5 or over 40 years.

The right kidney is more frequently affected bilateral growths are rare. Men are more often affected than women (227 to 73, Albarran)

Etiology.—The growths in infancy and childhood are congenital. There is no direct evidence that injury causes renal growths. Stone may coexist, but is not an important factor in etiology

Pathology and histology 1 **Carcinoma.**—Of recent years it has been shown that carcinoma is a rare growth of the kidney (7 per cent., Garceau) It originates in the renal tubules, and shows the following varieties of structure viz. (*a*) diffuse infiltration, the cells in some parts being arranged in masses or alveoli—adeno-carcinoma (Fig 545) (*b*) tubules lined with epithelium closely resembling the structure of normal kidney—adenoma-carcinoma (*c*) acini containing papillary growths—papillary adeno-carcinoma.

The tumours are usually small and on section are grey yellow or brown in colour with tracts of fibrous tissue.

2 **Sarcoma** is most common in children, and is more often bilateral than carcinoma. It may reach enormous proportions (33 lb. Van der Byl) The growth may arise from the capsule, from the perivascular connective tissue or in the substance of the kidney

On section the surface has a greyish, brain-like appearance and an alveolar arrangement in parts, and there is an ill-defined capsule These tumours are of the spindle- and small round-celled varieties

3. **Hypernephroma.**—These tumours in some respects resemble the cortex of the suprarenal gland in structure, and Grawitz claimed that they take origin in small aberrant nodules of suprarenal tissue found in the cortex of the kidney beneath the capsule. Stoerk has recently disputed their suprarenal origin, and looks upon them as papillomatous in structure. More recently Wilson and Willis have shown that they arise from the Wolffian body

The growths are most frequently found under the capsule and in the upper pole of the kidney the right being more frequently affected

than the left and male subjects more often than female. They are very rarely bilateral, and are the most common form of renal growth. The growth may become active at any age It is surrounded by a firm fibrous capsule and its substance is broken up by fibrous bands. The presence of a large quantity of fat in the cells gives the growth a characteristic yellow red colour Patches of necrosis and hæmorrhages are common. Microscopically there is a network of capillary vessels,

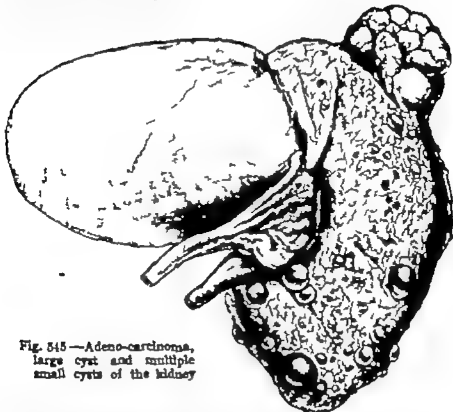


Fig. 545 —Adeno-carcinoma, large cyst and multiple small cysts of the kidney

and set directly upon these in one or several rows, are large polyhedral cells with clear protoplasm containing fat droplets. (Fig 546)

4. Mixed tumours.—These tumours usually arise during the first four years of life There is a basis of immature connective tissue the cells being round, oval, or spindle-shaped. In this are found embryonic striped muscle-fibres also non-striped muscle-fibres, cartilaginous nodules, fatty and elastic tissue and epithelial tubules. When striped muscle-fibres are abundant the growth is termed a "rhabdo-myo-sarcoma" when the epithelial elements are numerous the name "embryonic adeno-sarcoma" is used. These growths arise from the tissues of the sinus of the kidney and distend the organ (Bland-Sutton)

Extension and metastasis.—New growths of the kidney spread along the renal veins to the vena cava and extend to the perirenal tissues, suprarenal gland, lymph-glands, along the aorta and vena cava renal pelvis and ureter The most frequent seats of metastatic deposit in renal growths are the lungs, liver lymph-glands, bones, and rarely the second kidney the pleura omentum suprarenal gland, and brain.



Fig 546.—Hypernephroma of kidney papillary type.

Concomitant disease of the kidney such as movable kidney tuberculosis of the kidney or calculus occurs, but has no etiological value.

Symptoms.—The cardinal symptoms are hæmaturia and tumour Hæmaturia is present in over 90 per cent. of adult cases and is the first symptom in 70 per cent In children it is much less frequent (15 per cent) and occurs late The hæmaturia is spontaneous, intermittent and capricious, and is but little influenced by rest The blood

is well mixed and varies in quantity Ureteral clots like long slender worms are sometimes found, or there may be small maggot like clots in blood-stained urine

Clots may cause ureteric colic in passing and copious bleeding may fill the bladder with clotted blood and cause strangury and retention of urine.

Palpable tumour is present in the advanced stage of nearly all growths. In children it is the initial symptom in one-third of the cases. The tumour moves with respiration until it is fixed by adhesions.

Pain may be due to the passage of clots along the ureter or there may be renal aching from tension, which is unaffected by movement and only temporarily relieved by drugs. Costal neuralgia and radiating pain or sciatica from invasion of nerves by the growth may be present

Portions of the growth may occasionally be passed in the urine Albuminuria is due to toxic nephritis. Polyuria is sometimes observed Varicocele may develop suddenly or slowly and is usually a late symptom. It is due to pressure of enlarged glands or of the growth, or to engorgement of the capsular vein which anastomoses with the spermatic vein. It disappears after nephrectomy and should not be considered a contra-indication to operation. The development of a varicocele in a man past 35 should always lead to careful examination for renal tumour Cachexia appears late. A specific fever of a remittent or recurrent type is observed in 8 per cent of cases (Israel) Increased arterial tension has been noted and in hypernephroma an abnormally rapid pulse is not uncommon.

The X rays give a dense shadow with indefinite outline and metastatic nodules in the lungs can be clearly demonstrated by this means.

Course and prognosis.—The average duration of the disease from the appearance of the first symptom to the fatal issue is three and a half years (Garceau)

Diagnosis.—Where hematuria is the only symptom the disease can be localized to one kidney by the cystoscope. Cells and portions of the growth may be found in the urine, but exploration of the kidney is the sole certain method of diagnosis. Where tumour is the only symptom an exploratory laparotomy may be necessary to establish the diagnosis. Tumour with hematuria without other symptoms is characteristic of growth.

Treatment.—Palliative treatment consists in the administration of ergot, adrenalin, or calcium lactate to control hæmorrhage, and of opium and morphia to soothe pain. Nephrectomy is sometimes justifiable for the relief of pain, even when secondary growths are known to be present but is seldom necessary

Early total nephrectomy alone holds out a prospect of cure Operation is contra indicated where (a) the growth has spread beyond the

kidney (*b*) the second kidney is functionally inadequate (*c*) the patient is weak and cachectic or (*d*) the heart is dilated and feeble.

In all large growths the peritoneum should be opened and the peritoneal aspect of the tumour examined. The liver and lymph-glands should be examined. The efficiency of the second kidney must be previously determined and thoracic radiograms taken to exclude pulmonary metastases.

The ideal operation should remove the kidney and growth, adipose capsule, the lymphatic vessels, and the suprarenal capsule. Nephrectomy is performed by the lumbar route. The mortality of this operation for renal growth has fallen during recent years from 76 per cent (1885) to 11 per cent. (1913)

Recurrence takes place in 60 per cent of cases, and in over 70 per cent of these it occurs during the first year Recurrence is rare after the third or fourth year but has been described after four and a half years (Abbe) and five years (Witzel)

From 7 to 10 per cent of cases survive at the end of the fourth year without recurrence In children the operative mortality is higher (25 to 30 per cent) and recurrence is more rapid and certain (67 to 81 per cent of survivals) Cases are recorded in which the patients were alive and well twenty-six years (Malcolm—this case appears on re-examination of the growth to have been a simple adenoma) five years (Israel) and four years (Doderlein, Abbe) after operation.

TUMOURS OF THE RENAL PELVIS AND URETER

Primary growths of the renal pelvis are very rare Calculi have been present in the pelvis in some cases.

Pathology—Epithelial tumours (papilloma and epithelioma) are most frequent, while mesoblastic tumours (sarcoma, myxoma rhabdo-myoma and lipoma) are rare.

Papilloma is the commonest form, and is situated at the uretero-pelvic junction or in the ureter where it usually spreads from the renal pelvis, and may protrude into the bladder Primary papilloma of the ureter is rare (Thomson Walker three cases). The tumour closely resembles vesical papilloma and tends to become malignant. (Fig 547) The growths spread into the kidney and along the ureter Columnar-celled carcinoma is less frequent, and forms a nodular growth which rapidly spreads to neighbouring structures and forms metastases.

Obstruction at the outlet of the pelvis may cause hydronephrosis, which may become hæmatonephrosis or pyonephrosis.

Symptoms.—The symptoms are hæmaturia, pain and tumour Attacks of renal retention occur accompanied by intense renal and

ureteral pain and rapid enlargement of the kidney On cystoscopy a tumour may be seen projecting from the ureter and the ureteral catheter may draw blood and urine from the renal pelvis. The development of a very large hydronephrosis may be the principal symptom of primary papilloma of the ureter

Treatment.—Nephrectomy combined if necessary with ureterectomy is the only radical method. It may be necessary to remove the lower part of the ureter through the bladder after suprapubic cystotomy and to take with it an area of bladder wall around the ureteric orifice. Recurrence frequently takes place



Fig 547—Malignant growth of kidney and papillomatous growth of renal pelvis.

CYSTS OF THE KIDNEY

Apart from retention cysts of the kidney due to obstruction in the renal pelvis (hydronephrosis, pyonephrosis) there are several varieties of cysts, some of doubtful origin. These are as follows —

Multiple cysts in chronic nephritis.
Dermoid cysts.
Polycystic kidney and congenital cystic kidney
Solitary cysts or serous cysts.
Hydatid cysts.

Dermoid cysts are very rare only five or six examples having been recorded.

Polycystic Kidney (Congenital Cystic Kidney)

In this condition the kidney is transformed into a collection of cysts, and has an appearance almost like a bunch of grapes The disease may occur in several members of the same family Although probably always congenital, if not obvious at birth it may not

kidney (b) the second kidney is functionally inadequate, (c) the patient is weak and cachectic or (d) the heart is dilated and feeble.

In all large growths the peritoneum should be opened and the peritoneal aspect of the tumour examined. The liver and lymph-glands should be examined. The efficiency of the second kidney must be previously determined and thoracic radiograms taken to exclude pulmonary metastases.

The ideal operation should remove the kidney and growth, adipose capsule, the lymphatic vessels, and the suprarenal capsule. Nephrectomy is performed by the lumbar route. The mortality of this operation for renal growth has fallen during recent years from 76 per cent (1885) to 11 per cent (1913)

Recurrence takes place in 60 per cent. of cases and in over 70 per cent of these it occurs during the first year Recurrence is rare after the third or fourth year but has been described after four and a half years (Abbe) and five years (Witzel)

From 7 to 10 per cent of cases survive at the end of the fourth year without recurrence In children the operative mortality is higher (25 to 30 per cent) and recurrence is more rapid and certain (67 to 81 per cent of survivals) Cases are recorded in which the patients were alive and well twenty-six years (Malcolm—this case appears on re-examination of the growth to have been a simple adenoma) five years (Israel), and four years (Doderlein, Abbe) after operation.

TUMOURS OF THE RENAL PELVIS AND URETER

Primary growths of the renal pelvis are very rare Calculi have been present in the pelvis in some cases.

Pathology—Epithelial tumours (papilloma and epithelioma) are most frequent, while mesoblastic tumours (sarcoma, myxoma, rhabdo-myoma, and lipoma) are rare.

Papilloma is the commonest form and is situated at the uretero-pelvic junction or in the ureter where it usually spreads from the renal pelvis, and may protrude into the bladder Primary papilloma of the ureter is rare (Thomson Walker three cases) The tumour closely resembles vesical papilloma and tends to become malignant. (Fig 547) The growths spread into the kidney and along the ureter Columnar-celled carcinoma is less frequent, and forms a nodular growth which rapidly spreads to neighbouring structures and forms metastases.

Obstruction at the outlet of the pelvis may cause hydronephrosis, which may become hæmatonephrosis or pyonephrosis.

Symptoms.—The symptoms are hæmaturia, pain, and tumour Attacks of renal retention occur accompanied by intense renal and

Treatment.—From the fact that the disease is practically always bilateral, surgical intervention is ill advised. Nephrotomy with the evacuation of as many cysts as possible has been performed for pain and pyuria This operation appears to arrest for a time the progress of the disease and may be performed in the absence of severe symptoms. Nephrectomy is useless owing to the bilateral distribution.

Solitary Cysts

Large cysts of the kidney sometimes wrongly termed "serous" cysts, are very rare. (Fig. 545.) They are usually unilateral. Generally single, and of the size of an orange or larger the cyst has a thin, transparent fibrous wall incompletely lined with flattened or cubical epithelium, and is filled with a clear amber fluid containing albumin, chlorides, phosphates, and traces of urea, and occasionally blood. The interior frequently shows the remains of septa. Very rarely the cysts communicate with the pelvis. They are generally held to be retention cysts from blocking of tubules.

Symptoms.—Only the largest cysts cause symptoms. Dull aching pain, or more rarely sudden severe lumbar pain and vesical tenesmus, have been noted. A large cyst may produce pressure on the great veins and on the bowel. The urine is normal. The tumour has the characteristics of a renal tumour, and is most likely to be confused with hydronephrosis or new growth. The fixed volume, even after ureteral catheterization, and the normal outline of the renal pelvis on injection of sodium bromide or collargol (pyelography), show that there is no dilatation of the pelvis. A cyst of large size may be mistaken for an ovarian cyst. A correct diagnosis is made in only 8 per cent. of cases.

Treatment.—The cyst may be brought up to the surface and opened, and the cyst wall stitched to the skin. This is followed by fistula in half the cases.

Resection of the pouch should be carried out whenever possible. The salient part of the cyst wall is cut away and the portion of cyst wall within the kidney cauterized.

Partial nephrectomy may be performed if the cyst is at one pole. Total nephrectomy is the usual treatment for very large cysts.

Hydatid Cysts

The kidney is only affected in 0·065 per cent. of cases of hydatid disease (Thomas).

Pathology.—The embryo is arrested in the capillary plexus of the convoluted tubules, usually at one pole. The growth is slow but the cyst may finally increase rapidly in size. The neighbouring kidney tissue is destroyed by pressure. Active growth sometimes ceases and the cyst dies, shrinks, and the walls become calcified, the fluid being absorbed and the contents converted into a putty-like mass. A large cyst may rupture into the pelvis of the kidney and the daughter cysts be passed in the urine. The cyst may now collapse and die, or it may refill and rupture again after some years. Rupture into the stomach, intestine, lung, or peritoneal cavity may take place. Suppuration frequently follows rupture, and is a grave complication.

Symptoms.—A painless, globular tumour not moving with respiration is found in the position of the kidney which may be detected attached to the tumour. Percussion is dull or tympanitic on the anterior surface. The cyst is hard, and fluctuation is seldom detected. The urine is normal.

conspicuously develop till adult life. It is most commonly observed during infancy or between the ages of 40 and 50. Women are more frequently affected than men. The disease is practically always bilateral though it may be more advanced in one kidney than in the other. The organ may reach enormous proportions, and is converted into a mass of cysts varying from a pin's head to a cherry in size.

The contents are a clear yellow sometimes brownish fluid which holds in suspension cortical and columnar epithelial cells, tube-casts, red blood-corpuscles, leucocytes and occasionally uric-acid and calcium oxalate crystals. Urea is present in small quantities, and albumin, phosphates, chlorides, and cholesterin.

The intercystic kidney tissue may be invisible to the naked eye. The wall of the cysts consists of connective tissue lined by columnar cubical, or flattened epithelium.

Coincident cystic changes are present in the liver in 18 per cent. of cases. The liver cysts are due to dilatation of biliary canals, and are not usually numerous.

In a few cases cystic changes have also been found in the pancreas, spleen, thyroid, ovaries, uterus, and seminal vesicles. Hypertrophy of the heart and arterio-sclerosis are frequently present.

Pathology.—The condition is believed to develop from failure of the excretory canals and convoluted tubules which are developed from separate structures, to unite. In the early stage the cysts formed from the renal vesicle develop in the cortex.

The cysts are also said, with less probability to result from inflammation of the renal papilla or from neoplasm.

Symptoms.—If the cystic condition is very advanced in the infant, the large size of the kidney may cause difficulty in labour and the child usually soon dies with uræmic symptoms.

In the adult, many cases present no symptoms at all. Frequently however after a long latent period, a renal tumour appears with somewhat indeterminate symptoms, which ultimately progress to those of renal failure.

In the second or tumour stage a large swelling presenting the renal characteristics appears on one side, the second kidney not yet being enlarged on palpation. Tenderness is rare pain is late, and consists of a dull aching in the loin with an occasional colic due to the passage of clots. There may be albuminuria and pronounced polyuria interrupted by periods of oliguria. Hæmaturia, when present is slight and intermittent. Recurrent attacks of lumbar pain and tenderness with rigidity of the abdominal muscles and an elevated temperature are due to rupture of the superficial cysts and resulting perinephritis. In the last stage there is bilateral tumour the urine becomes scanty and anuria supervenes.

same tumour In malignant growths metastases take place by the blood stream, and deposits are found in the lungs, bones, and liver

Symptoms.—Hæmaturia is very rare, and is due to passive congestion of the kidney from invasion of the renal vein. Progressive emaciation with profound anæmia is the most characteristic feature; anorexia, vomiting, constipation, and sometimes œdema are observed. Pigmentary changes very rarely develop. In children there may be arrest of mental development. There may be unilateral hypertrophy precocious puberty and excessive genital development. At first hidden under the ribs, the tumour is later detected in the hypochondriac region behind the bowel. The kidney may sometimes be recognized below it. Pain is frequent and is sometimes referred to distant parts. The growth is often only discovered post mortem.

Diagnosis.—The majority of cases are diagnosed as renal growths. The characteristic features are the absence of changes in the urine, early and extreme emaciation, pigmentary and developmental changes, the level of the tumour at the 7th or 8th costal cartilages, the lower border of the suprarenal growth being broad and almost horizontal. Pyelography may aid in distinguishing the origin of the growth.

Prognosis and treatment.—The average duration of life after symptoms appear is from six to ten months (Ramsay). Early removal of the growth with the kidney is the only radical method. There is danger of severe hæmorrhage and of opening the pleural cavity during separation of adhesions. Rapid recurrence after removal is the rule.

TUBERCULOSIS OF THE KIDNEY AND URETER

Tuberculosis of the urinary organs may exist alone or may be secondary to tuberculosis of the genital system or to tuberculosis of some other organ such as the lung The combination of genital and urinary tuberculosis is very frequent in the male, rare in the female.

Tuberculosis of the kidney is said to be primary or secondary The term primary is used in the narrow sense that the kidney is the primary focus in the urinary system.

Renal tuberculosis occurs—(1) as a part of acute miliary tuberculosis, both kidneys being strewn with miliary tubercles (2) as a tuberculous infiltration of the kidney Miliary tuberculosis is met with, especially in early childhood as an insignificant part of a general tuberculous infection. It has no surgical interest.

Method of infection.—The bacilli reach the kidney by one of three paths—(1) ascending (secondary renal tuberculosis) (2) hæmatogenous (primary renal tuberculosis) (3) lymphatic.

Although ascending tuberculosis has been proved experimentally to be possible it is doubtful if it ever occurs clinically

Hæmatogenous infection is the method by which the kidney is attacked in the great majority of cases. Lymphatic infection from the mediastinal lymph-glands infected from a bygone pleurisy is said to occur frequently (Brongersma) but proof of this is lacking

Etiology—Renal tuberculosis is most frequent between the ages of 20 and 40 it is uncommon in childhood and rare in old age

Rupture occurs very frequently and is accompanied by renal pain and ureteric colic, vomiting, and collapse. The urine becomes turbid, is alkaline, and contains small hydatid cysts (complete or ruptured), scoleces, booklets, fat droplets, and sometimes blood. Frequent micturition, strangury and even retention of urine may be caused. Rupture may be followed by toxæmia, high temperature, urticaria, and occasionally convulsions.

Diagnosis.—Hydatids grow very slowly are painless, and show no variations in size. Ureteral catheterization and pyelography exclude dilatation of the kidney Polycystic kidney is bilateral, while hydatid and solitary cysts are unilateral. Exposure of the individual to contagion, a hydatid thrill, if obtainable, hooklets or cysts in the urine, when rupture has taken place, assist in diagnosis. Eosinophilia is present, and recently a "complement-fixation" diagnostic reaction has been successfully employed.

Treatment.—Nephrectomy should only be performed when conservative measures are impossible, or when suppuration or rupture has taken place. The mortality is 10 per cent. Resection or partial nephrectomy is only applicable in small cysts.

The pouch may be "marsupialized," and washed daily with iodine solution. After removal of as much of the cyst as possible, the opposing surfaces may be stitched together with catgut.

PERIRENAL TUMOURS

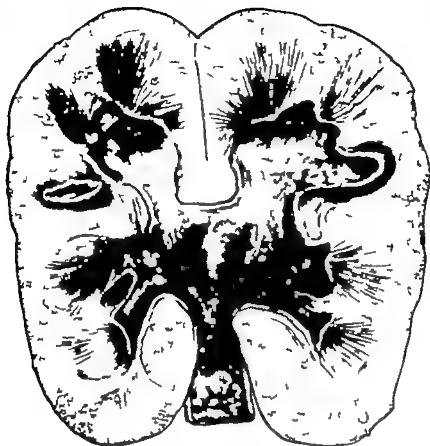
These are rare, but of wide variety Lipoma, fibroma, fibro-myoma, and mixtures of these may grow from the capsule or at the renal hilum but are usually small; sarcomas are also found. Mixed tumours are rare they arise from Wolffian remains and resemble renal mixed tumours in structure. Perirenal cysts are believed to arise in Wolffian remains or in detached portions of embryonic peritoneum (Bamband).

Perirenal tumours may be large and cause pressure-atrophy of the kidney or obstruction of the ureter.

Tumour formation, slow except in sarcomas, is the only constant symptom, but pressure symptoms may be present. The urine is normal. Early removal is required, by the lumbar route for small tumours, transperitoneally for large ones. The kidney should be saved, if possible, except when the growth is sarcomatous.

TUMOURS OF THE SUPRARENAL GLAND

These growths are rare they resemble the structure of the gland, and are grouped under the name hypernephroma. Isolated examples have been described of glioma, neuroma, glio-fibroma, angioma, lymphangioma, lipoma, and cysts. About one-third of the new growths of the adrenals are found in infancy and childhood. Females are more frequently affected than males, and the left side more often than the right. Hypernephroma may be benign or malignant, and has the histological characters of the cortex of the suprarenal gland. There is a framework of capillary blood vessels upon which large, polygonal, frequently vacuolated cells are regularly arranged. In the meshes of the vascular network the cells become arranged in alveolar form or in long columns. The vacuoles in the cells frequently contain fat, and pigment granules may be found in the protoplasm. The tumours are single or multiple. They are rounded, possess a fibrous capsule and a characteristic yellow colour and frequently show hæmorrhages. In the benign hypernephroma the cells are smaller more uniform in size, and regular in arrangement. Transition between simple and malignant forms is seen in the



Tuberculous disease of the kidney

PLATE 104

Women are the more frequently affected, and the right kidney more often than the left. Tuberculous disease is unilateral in from 85 per cent. (Legueu) to 92 per cent. (Krönlein) of cases in the early stage In the late stage it is bilateral in 53·3 per cent. In children it is bilateral in 53 per cent. of cases. Secondary infections with B coli the streptococcus, and the staphylococcus may occur

Pathological anatomy.—The following varieties may be enumerated —

1 *Miliary tuberculosis.*

2 **Ulcero-cavernous form.**—This, the common form, commences with congestion and ulceration at the apex of a pyramid at one pole and progresses from the pelvis outwards until the pyramid is entirely hollowed out. Other pyramids are attacked, and the pockets may unite to form larger cavities. (Plate 104)

Tubercles may dot the cortex, singly or in groups, or may entirely permeate it At the mouth of a calyx or of a large branch of the pelvis into which the ulcerated calyces open there is thickening of the wall and narrowing of the outlet which may temporarily shut off this part from the urinary tract

3 **Tuberculous hydronephrosis**—Where thickening and contraction of the wall of one part of the pelvis or of a single calyx continues to the point of obliteration, or where the same process develops at the outlet of the ureter a partial or total tuberculous hydronephrosis results. The fluid content is pale and turbid with white flakes and the lining irregular and greyish white.

4 **Massive caseous tuberculosis.**—Large rounded masses of caseous material are formed and the whole kidney may be converted into a capsule with compartments containing these masses. This is a very chronic variety of the ulcero-cavernous form. The organ is completely destroyed and the tuberculous infection is quiescent.

Parenchymatous and interstitial nephritis and waxy disease are observed in the kidneys of tuberculous patients, and are due to the poisons produced by the tubercle bacillus.

Tuberculous lesions are found in the renal pelvis and ureter Stenosis of the pelvic outlet causes hydronephrosis The fatty capsule and fat around the renal vessels are greatly thickened, coarse, fibrous, and densely adherent Enlarged lymph-glands are present Giant-cell systems may be found in the perirenal fat

Symptoms. 1 **Vesical symptoms.**—The symptoms may be entirely confined to the bladder The onset is insidious, with gradually increasing frequency of micturition, at first during the day and later at night also

2 **Changes in the urine**—Polyuria is an early symptom. It exists only on the diseased side and is more marked at night The

urine is abundant very pale and opalescent faintly acid or neutral and hazy with a small amount of pus well mixed with the urine The urea and chlorides are reduced Hæmaturia may be entirely absent or only present in microscopic amount There may be slight persistent terminal hæmaturia or a considerable outburst of hæmorrhage which may precede other symptoms by many months and recur during the course of the disease Albuminuria may be present independently of pyuria or hæmaturia

3. **Pain.**—The kidney may be completely destroyed without pain but renal aching is sometimes present and the patient may be unable to lie on the affected side Ureteral colic may be caused by the passage of clots or débris Pain at the neck of the bladder and at the end of the penis is due to cystitis.

4. **Other symptoms.**—On examination the tuberculous kidney is not usually enlarged. If palpable it may be hard and irregular It is frequently tender In the late stage it may be small shrunken and not palpable or it may be hydronephrotic and enlarged.

There is frequently tenderness along the line of the ureter which can be felt as a thick cord on deep palpation of the abdomen or on rectal or vaginal examination.

The second kidney may be enlarged, painful and tender from hypertrophy with or without commencing tuberculosis.

There is progressive loss of weight and lassitude

The temperature may show occasional slight rises to 99 or 100 F., or there may be a daily slight rise. Tuberculosis of the kidney does not cause a high temperature (102–103 F.) and if such is present it is due either to a secondary infection or to tuberculosis elsewhere in the body

Course and prognosis.—The course is slow and remission of the symptoms for weeks and even months may be observed The disease gradually advances until death takes place some years (seven or even ten) after the onset of the symptoms. The lesions progress until the kidney is completely destroyed during this time the bladder and the second kidney become affected. Septic infection may be superadded either by hæmatogenous infection or more frequently by ascending infection from septic cystitis caused by catheterization or bladder washing General tuberculosis rarely follows. Death takes place from anuria when both kidneys are invaded or from exhaustion due to septic infection.

Diagnosis.—The diagnosis can usually be made by the discovery of tubercle bacilli with pus or blood in the urine but when the ureter is completely blocked no changes may be observed in the urine In doubtful cases von Pirquet's and Calmette's tests may be useful. It is necessary to localize the disease to the kidney and to ascertain

which kidney is affected. The presence of symptoms such as pain and enlargement of the kidney is not always reliable, for a hypertrophied healthy kidney may be enlarged and ache, while a kidney destroyed by tubercle may not be palpable, painful or tender

On cystoscopy general cystitis without typical tuberculous appearances may be found, or there may be tubercles or ulceration of the vesical mucous membrane or a collection of tiny cysts grouped around one ureteric orifice. The orifice may be open, trumpet-shaped, and extensively ulcerated. In old-standing tuberculosis of the kidney the ureteric orifice may be dragged upwards and outwards, and appear like a tunnel (Fenwick)

The urine of each kidney should be obtained by means of the ureteric catheter and examined for tubercle bacilli, pus, blood-casts, etc

Treatment. 1 **Tuberculin**—Amelioration of symptoms, and in some cases disappearance of pus and tubercle bacilli from the urine, may be observed, but recurrence of the symptoms may take place after some months or years. Tuberculin treatment is recommended in —(a) cases of unilateral renal tuberculosis where nephrectomy has been refused, (b) vesical tuberculosis after nephrectomy (c) bilateral renal tuberculosis, (d) renal with active extra urinary tuberculosis, and (e) renal tuberculosis in children, on account of the great frequency of bilateral disease.

2. **Climatic and medicinal**—A warm equable climate is most suitable (parts of Egypt, Morocco South Africa) Nourishing diet, with plenty of milk and fats, should be recommended. Hexamine is unnecessary if no septic infection be present, and it may irritate the hypersensitive bladder Sandalwood oil soothes the vesical irritation. Washing the bladder is useless therapeutically and involves great danger of introducing sepsis.

3 **Operative** *Nephrectomy*—Nephrectomy in the early stage of renal tuberculosis is the only method by which a cure can be assured and the operation is indicated whenever the diagnosis of unilateral renal tuberculosis is made.

Nephrectomy is contra-indicated in—(i) Bilateral renal tuberculosis but nephrectomy of the more advanced organ is sometimes advocated to diminish the toxæmia.

(ii) Non tuberculous nephritis of the second kidney but if the tests for the function of this kidney be satisfactory nephrectomy should be performed.

(iii) Tuberculous lesions of the bladder although these do not contra indicate nephrectomy if the second kidney can be proved healthy After nephrectomy the cystitis either subsides spontaneously or disappears under tuberculin.

(iv) Tuberculous lesions of other organs but obsolete tuberculous

foci such as spinal curvature ankylosed joints healed tuberculous disease of bones, etc. do not contra indicate nephrectomy. Moreover in active but limited tuberculous disease of the genital organs, nephrectomy may be performed. In active disease of the lungs or other organs nephrectomy is contra indicated.

(v) A generally enfeebled state of the patient

The following procedures may be carried out in regard to the ureter (i) The upper end may be fixed in the lumbar wound. This usually leads to tuberculous infection of the wound, and is not recommended. (ii) The ureter may be ligatured, cauterized and dropped into the retroperitoneal space. The ureteral disease usually subsides and gives no further trouble but occasionally cystitis is kept up (iii) The ureter is excised. This is done at the time of the nephrectomy by prolonging the incision. The ureter is stripped from the peritoneum and followed into the pelvis, where it is ligatured and cut across. Some inches of the tube usually remain. Kelly suggests removing the lower end through the vagina with a portion of the bladder wall. (iv) My practice is to remove the ureter as far as the brim of the pelvis at the time of the nephrectomy. If the vesical symptoms continue and appear to be due to the remaining portion of the tuberculous ureter a second operation is performed six months later for extraperitoneal excision of the ureter through a median incision.

Results of nephrectomy for primary tuberculosis.—Brongersma has shown an immediate mortality of 7 [redacted] per cent in 513 cases of nephrectomy by ten surgeons. Where the modern methods of diagnosis were used to exclude unsuitable cases the mortality fell to 2·85 per cent. There is a risk, amounting to 10·6 per cent of the patient dying of tuberculosis during the first two years, and a risk of 3·12 per cent of a fatal result from tuberculosis after that.

Nephrotomy.—This is a preliminary or a palliative operation when the patient is much enfeebled from toxæmia or for pyonephrosis due to secondary infection, and very rarely for great pain or severe hæmorrhage.

SYPHILIS OF THE KIDNEY

Nephritis due to *secondary* syphilis is rare, and always bilateral. In slight cases there is a trace of albumin in the urine and rather marked œdema. In severe cases there is oliguria, pronounced albuminuria, with epithelial casts and a few leucocytes in the urine, nausea, vomiting, anasarca, and eventually uræmia, and in such cases interstitial nephritis with changes in the glomeruli and blood vessels are usually found.

Tertiary syphilis may give rise to subacute or chronic interstitial nephritis, or less frequently a parenchymatous nephritis. The disease may be unilateral, and may affect only one part of the kidney. Scarring of the kidney is sometimes found. Gummata are single or multiple. When a large gumma is present the kidney is enlarged, hard, and irregular. Such kidneys have been removed for malignant growth or tuberculous disease. Amyloid degeneration

are branched, and the branches fill the calyces. (Plate 105.) Ca
of 1½ lb (Sheild) and 3 lb (Le Dentu) have been found. A cal
has very rarely been found embedded in the substance of the kid

Changes in the kidney.—When a large stone is present
kidney is destroyed by pressure and there is extensive perineph
Complete or partial hydronephrosis or pyonephrosis may develop

Symptoms.—Occasionally a calculus lies quiescent for r
years. Persistent cystitis may be present but no symptoms of

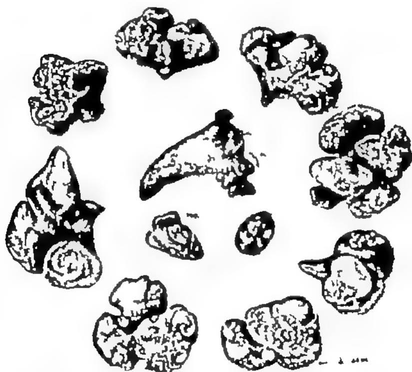


Fig 548.—Calculi removed from one kidney

disease. In some cases there are signs of profound toxæmia du
pyelonephritis without symptoms of stone. The cardinal sympt
are pain (70 per cent.) and hæmaturia. Pain may be fixed r
pain or renal colic. The former is a constant ache of varying in
sity increased by movement and relieved by rest. In walking
body may be inclined to the diseased side and when lying the t
is flexed. The greatest pain is produced by a small round or r
rough crystalline stone free in the renal pelvis.

Renal colic commences over the kidney and radiates along
line of the ureter to the external abdominal ring or into the test



Multiple calculi of the kidney

PLATE 105.

which is retracted or it may shoot along the urethra to the tip of the penis. In a severe attack the patient rolls in agony the face is pale the skin clammy and sweating and vomiting occurs. The abdominal muscles are rigid and the thigh flexed There may be intense desire to micturate but anuria may be present If unrelieved by treatment the attack lasts for one or several hours and then ceases suddenly or gradually After an interval a quantity of blood-stained urine may be passed Referred pain may be observed in the testicle labium thigh, leg sole of the foot or heel There may be bladder pain and irritation when the bladder is healthy Pain may be referred to the second kidney but if that organ is healthy the referred pain is always accompanied by pain in the diseased kidney

Hæmaturia is present in less than half the cases It may be microscopic moderate or copious and is intimately connected with movement and exertion

Pyuria may be moderate but if there is pyonephrosis it is abundant and intermittent

The urine is usually acid rarely alkaline and decomposing It may contain hyaline casts crystals of calcium oxalate or uric acid Phosphaturia may be present

Polyuria is a late symptom, and calculous anuria may supervene The kidney is occasionally tender, the abdominal muscles are rigid An abdominal swelling may be formed and rarely a large collection of stones is felt as a hard, irregular craggy grating mass.

On cystoscopic examination there is unilateral hæmaturia or pyuria. Elongation of the ureteric orifice and inflammation surrounding the opening may be observed. Radiography shows a shadow of the calculus.

Course and complications.—As the stone increases in size the pain diminishes. Renal calculus may exist for years without causing grave inconvenience The complications that may occur are —(1) migration with renal colic, (2) obstruction with calculous hydronephrosis or calculous anuria (3) infection causing pyelitis pyelonephritis pyonephrosis perinephritis and perinephritic abscess.

Diagnosis.—The most important symptoms are the severity of the pain and the effect on it and on hæmaturia of movement and jarring. The previous passage of a calculus and the presence of numerous crystals in the urine are important.

Apart from stone, renal colic may result from undue mobility of the kidney from ureteritis, or from the passage of blood-clot, débris, or large quantities of uric-acid or oxalate crystals. Renal pain may be caused by nephritis, and simulated by the crises of locomotor ataxy by hysteria, by osteo-arthritis of the lumbar vertebræ and by hepatic colic.

The final test is the X ray examination.

In cases where cystitis is the prominent feature the cystoscope will show a purulent efflux on one side, which will lead to a diagnosis.

Before operation is undertaken it is necessary to ascertain the presence and health of the second kidney by cystoscopy chromo-cystoscopy and examination of the urine drawn from the ureter of the second kidney by the ureteral catheter

Prophylactic treatment.—This consists in the treatment of oxaluria, phosphaturia, and lithiasis, and the removal of local conditions which may assist the formation of stone, viz. urinary infection and obstruction.

Treatment of symptoms. *Renal colic.*—The patient is placed in a hot bath and a hypodermic injection of morphine sulphate ($\frac{1}{4}$ to $\frac{1}{2}$ gr) with atropine sulphate ($\frac{1}{150}$ gr) administered. Hot fomentations or poultices are applied over the loin and abdomen. Very rarely it is found necessary to keep the patient lightly under the influence of chloroform for an hour or more.

Renal hæmaturia.—This is occasionally severe after a fall or blow The patient should rest in bed with an ice-bag over the kidney A hypodermic injection of morphia should be given, and 10 to 15 gr of calcium lactate administered by mouth every four hours. For persistent and severe hæmaturia, operation is necessary

Calculous anuria. (*See* p 878.)

Operative treatment.—When the diagnosis is made the stone should unless in some exceptional cases, be removed without delay

Cases of extensive bilateral calculous disease with progressive renal failure or with widespread sepsis, and cases in which small calculi are frequently passed and the X-rays do not show a large single shadow or a collection of small shadows in the kidney are unsuitable for operation.

1 Nephrolithotomy — The kidney is exposed by a curved lumbar incision which commences well above the costo-muscular angle, and the stone removed by incision through the convex border or just posterior to it. The pelvis and ureter are also examined. As little damage as possible is done to the kidney tissue. If the stone is small and lies in a calyx, a blunt-grooved probe should be passed through the convex border of the kidney down to the stone and a small incision made along the probe. The stone is removed with the author s stone-forceps.

The nephrotomy wound is closed with catgut in rounded needles. When there is sepsis and dilatation of the kidney a medium-sized drain should be placed in the kidney wound *The dangers of nephrolithotomy* are hæmorrhage and septic infection. Postoperative hæmorrhage is usually due to sepsis or to tearing out of ligatures. When

slight it may be controlled by morphia and calcium lactate but if copious and persistent exposure and packing of the kidney may be necessary and sometimes nephrectomy is required.

Results—In aseptic kidneys when dilatation is not present the mortality is 2·2 per cent (Watson) In infected cases the death-rate is as high as 20·3 per cent. (Schmieden) In infected cases a fistula may persist and this may also result from calculi having been left in the kidney or from ureteral or pelvic obstruction. Fistulæ occur in 8·1 per cent of all cases (Watson) and in 23·2 per cent. of infected cases (Schmieden)

2. Pyelolithotomy —The calculus is removed through an incision in the posterior wall of the pelvis of the kidney The kidney is drawn out of the lumbar wound and turned forwards and upwards, a longitudinal incision made in the wall of the pelvis, and the stone removed. The edges of the opening are then stitched with fine catgut. I turn down a flap of kidney capsule and cover the closed incision to prevent leakage. Mayo recommends a flap of fatty tissue for the same purpose. A small drainage-tube is inserted down to the pelvis and retained for three or four days until the danger of leakage is past. Pyelolithotomy is suitable for calculi of moderate size in the pelvis or small calculi in a calyx. It must be possible to draw the kidney out of the wound and turn it over or turn it over in the wound, so as to expose the posterior wall of the pelvis.

The operation is unsuitable for large or branched calculi, or for cases where the kidney cannot be mobilised. There is no danger of hæmorrhage and no destruction of kidney tissue

Fistulæ are said to be more frequent after this operation but that is not the author's experience.

Results.—The mortality in 54 uncomplicated cases was 11·1 per cent., and a fistula remained in 22·2 per cent. (Schmieden)

3. Nephrectomy.—Primary nephrectomy is rarely performed for calculus. It may be necessary—(1) in severe uncontrollable hæmorrhage during or after nephrolithotomy (2) when the kidney is atrophied or destroyed by suppuration, (3) when calculi are so numerous and large that they cannot be removed without destroying the kidney (4) when a malignant growth is present.

Secondary nephrectomy may be called for in—(1) urinary fistula causing great discomfort and irremediable by other means (2) recurrence of stone with atrophy of the kidney (3) prolonged renal suppuration.

Results—Primary nephrectomy for calculus has a mortality of 30·1 per cent., and secondary nephrectomy 18·1 per cent (Watson)

Bilateral calculi and calculi in a solitary kidney—It is unwise to remove the stones from both kidneys at the same operation. The

less affected kidney should first be operated upon, in case it may become necessary to perform nephrectomy on the second kidney later

Statistics show a mortality of 35 per cent in operations on double calculi (Küster) In operating on a solitary kidney pyelolithotomy should be preferred to nephrolithotomy

CALCULOUS ANURIA

Calculous anuria occurs usually in men between the ages of 40 and 60 The calculus is small and single and the exciting cause is violent exercise, shaking or jarring

Pathology—There is usually only one calculus, which is arrested at the upper end of the ureter (61 per cent.) the lower part (28 per cent.) or the middle (11 per cent.) The obstructed kidney is large and deeply congested with ecchymoses on the surface and the pelvis contains 2 or 3 drachms of blood-stained urine under considerable tension. The second kidney is always the seat of organic disease, usually interstitial nephritis. In a few cases this ureter is also blocked by calculus and rarely there is congenital absence of the second kidney

The suppression on the affected side is due to sudden, complete obstruction by the impacted calculus ; that on the opposite side is usually reflex.

The following conditions may be found

1 The ureter of a single functional kidney blocked by stone ; the second kidney absent, atrophied, or completely destroyed by disease.

2 The ureters of two functional kidneys simultaneously blocked by stones.

3 The ureter of one functional kidney blocked by stone and the function of the second kidney which is diseased suppressed by reflex influences.

Symptoms.—The kidney on the recently affected side is frequently enlarged and tender and there is rigidity of the abdominal muscles, especially marked on this side. There may be tenderness per rectum along the line of the ureter and of the lower end of the ureters. The calculus can sometimes be detected by the finger in the rectum or vagina On cystoscopic examination the ureteric orifice on the recently diseased side is congested or even ecchymosed.

A severe attack of ureteric colic usually precedes the onset of the anuria, but suppression may supervene without pain or other symptom.

The course of calculous anuria is divided into two stages

1 **A period of tolerance.**—The average duration of this stage is five or six days, and the longest sixteen days. The anuria may be

absolute but frequently a little urine is secreted or there are one or more intervals of copious polyuria.

After some days, digestive disturbances appear and the appetite fails. There are nausea, constipation and flatulence, sleeplessness, irritability, headache and lassitude.

2. **A period of intoxication**.—This stage commences about the fifth or seventh day. Drowsiness and eventually hallucinations and muttering delirium supervene. The pupils are contracted and twitchings of the muscles occur, but convulsions are absent. There may be inability to move one or both legs, and the knee-jerks are slow or abolished. The pulse and respiration are slow and irregular and eventually Cheyne-Stokes respiration develops. The temperature is subnormal. Œdema is usually absent. Hiccup and vomiting are frequent symptoms. The bowels are constipated. The patient dies either during an attack of dyspnœa or from increasing coma and gradual heart failure.

Diagnosis. 1. **What is the cause of the anuria?**—Previous attacks of colic, and the history of calculi, or the detection of a calculus in the ureter by the finger in the rectum or by radiography and cystoscopy may aid diagnosis. The absence of fever excludes pyelonephritis as a cause.

Other forms of obstruction, such as bladder or pelvic growths, must be excluded. The history and examination readily exclude anuria resulting from advanced tuberculous disease, polycystic disease, or chronic nephritis, and the symptoms are unlike those of acute nephritis.

2. **Which side is affected?**—When there is a history of bilateral ureteral colic the side of the recent pain is that of the active kidney and recently blocked ureter. The abdominal muscles are rigid on the affected side. The kidney is tender and may be enlarged and the ureter also is tender.

Extensive radiographic shadows in one kidney show that this organ was previously destroyed, and a shadow in the line of the opposite ureter would indicate and localize the cause of the anuria.

Catheterization of the ureter may demonstrate the affected side and the position of the stone.

Prognosis.—Death occurs in 71 per cent. of unoperated cases (Legueu) usually on the tenth or twelfth day. In cases which recover spontaneously relief is usually obtained on the fifth to the tenth day.

Treatment.—Operation should be performed at the earliest possible moment in all cases. The mortality rises each day the operation is delayed from 25 per cent. before the fourth day to 42 per cent. before the sixth day. In addition other means should be adopted to re-establish the secretion. Diuretics such as Contrexéville water

tea, theocin sodium acetate (4 gr every four hours) combined with digitalis, should be given. Two pints of normal saline or a 2½-per-cent. solution of glucose should be infused into a vein during or after the operation. A purge should be administered, and every means taken by hot packs and vapour baths to obtain a free action of the skin. The nature of the operation depends on the position of the obstructing stone the possibility of localizing it, and the ease or difficulty with which it can be removed. It is more important to relieve the obstruction quickly than to remove the calculus. Nephrotomy should be performed when the stone is localized to the pelvis, when no accurate localization has been possible, or when it has been localized to the ureter but its position would necessitate a prolonged operation for its removal. If the stone is found it should be removed if it is not found a large drainage-tube is placed in the renal pelvis and the kidney wound lightly packed with gauze. The obstructing calculus can be removed later

Pyelotomy or ureterotomy may be substituted for nephrotomy when the stone is readily accessible. In some cases a temporary relief from the obstruction may be obtained by passing a ureteral catheter and partly dislodging the stone but this method cannot be regarded as more than a temporary measure.

The mortality of cases treated by operation is 46 3 per cent.

THE URETER

Anatomy.—The ureter narrows at its junction with the renal pelvis near the lower pole of the kidney again at the pelvic brim, and again at its entrance into the bladder. As seen in radiography the upper end of the ureter lies at the tip of the transverse process of the 2nd lumbar vertebra; thence the duct descends across the tip of the transverse process of the 3rd and the transverse processes of the 4th and 5th lumbar vertebræ, and passes vertically across the pelvic brim, internally to the sacro-iliac synchondrosis. It then curves outwards across the outer border of the sacrum and ischial spine, and turns inwards above the shadow thrown by the horizontal ramus of the pubic bone.

The ureter is adherent to the peritoneum, and, when the membrane is raised, remains attached to it. In the male its terminal extravesical portion is crossed by the vas deferens. In the female it crosses beneath the broad ligament, and alongside and then in front of the lateral fornix of the vagina and the cervix uteri. Here it passes below and behind the uterine artery and is surrounded by a dense venous plexus.

The intramural portion is ¾ in. long, and passes very obliquely through the bladder The ureteric orifices open on the bladder base, ¾ in. to 1 in. apart.

Examination.—On deep palpation, in a favourable subject, a thickened ureter can be felt lying alongside the vertebral column or where it crosses the brim of the pelvis.

On rectal palpation, in the male the ureter is felt above and outside

the base of the prostate and in the female it may be felt in the anterior and lateral walls at the junction of the middle and upper thirds of the vagina.

The appearance, movements, and efflux of the vesical orifice of the ureter are examined by cystoscopy or by Kelly's tube.

The urine of each kidney is obtained by ureteral catheterization (p. 818).

The X rays sometimes show the shadow of a much dilated or greatly thickened ureter. Calculi impacted in the ureter throw a radiographic shadow in the line of the duct (Plate 83, Fig. 1, Vol. I, facing p. 608). In pyelography (p. 836) the opaque solution may fill the ureter and show a dilated, kinked or strictured duct.

It is sometimes necessary to pass an opaque bougie up the ureter in order to define the line of the duct and the position of a doubtful shadow. The ureter may be sounded for stone by passing a ureteric catheter or a wax tipped bougie and the presence of stricture can be demonstrated by the passage of ureteral bougies.

PROLAPSE

There may be unilateral or bilateral prolapse of the whole thickness of the ureteral wall or of the mucous membrane alone. A globular or sausage-shaped cyst is formed, varying in size from a pea to a walnut or larger. The wall consists of a double layer of mucous membrane and at the summit of the swelling the stenosed ureteric orifice opens. Calculi are sometimes found in the sac. The condition may result from a congenital narrowing of the ureteric orifice or an acquired stenosis from ureteritis. The symptoms are irregular. There may be pain in the kidney or ureter or symptoms of vesical irritation or of urethral obstruction. Occasionally there is complete retention. Attacks of hæmaturia may be the only symptom. The cyst may appear at the external meatus in the female subject. The cystoscope shows a pink, semi-translucent, globular or sausage-shaped swelling over which fine blood vessels course. The cyst may slowly fill and slowly collapse under observation. Treatment consists in destroying the cyst with the high frequency cautery (diathermy) or with ureteral scissors through an operating cystoscope or in cystotomy and cutting off the pouch at its base with scissors and removing any calculi that are present.

INJURIES

1 Subcutaneous Injuries and Penetrating Wounds

Injuries of this nature are rare. The peritoneum is simultaneously ruptured in 8 per cent. of cases. The duct is injured by impact against the transverse process of a lumbar vertebra or by overstretching. Urine accumulates in the retroperitoneal space or leaks into the peritoneum.

Symptoms.—There are pain and tenderness, which pass off in a few days if the injury is uncomplicated. A swelling appears in the loin in a few days or after some weeks. It is rounded or elongated and well defined, and may assume a large size. Suppuration takes place and the temperature rises. It is impossible to diagnose between a rupture of the ureter and rupture of the renal pelvis. A urinary fistula follows penetrating wounds of the ureter. The prognosis is good when early operation is performed.

Treatment.—Operation should immediately follow diagnosis. It is difficult to find the end of the ureter when it is completely torn across, and a catheter should be passed up the duct from the bladder before commencing the operation. The ends, when identified should if possible be anastomosed but this is not often possible as the injured ureter is surrounded by dense

tea theocin sodium acetate (4 gr every four hours) combined with digitalis, should be given. Two pints of normal saline or a 2½-per-cent. solution of glucose should be infused into a vein during or after the operation. A purge should be administered, and every means taken by hot packs and vapour baths to obtain a free action of the skin. The nature of the operation depends on the position of the obstructing stone, the possibility of localizing it, and the ease or difficulty with which it can be removed. It is more important to relieve the obstruction quickly than to remove the calculus. Nephrotomy should be performed when the stone is localized to the pelvis when no accurate localization has been possible, or when it has been localized to the ureter but its position would necessitate a prolonged operation for its removal. If the stone is found it should be removed if it is not found a large drainage-tube is placed in the renal pelvis and the kidney wound lightly packed with gauze. The obstructing calculus can be removed later.

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Examination.—On deep palpation, in a favourable subject, a thickened ureter can be felt lying alongside the vertebral column or where it crosses the brim of the pelvis.

On rectal palpation, in the male the ureter is felt above and outside

The position of the fistula is ascertained by sounding the ureter with an opaque bougie and obtaining a radiogram.

Treatment.—The introduction of a catheter *en demeure* is impossible in many cases on account of the stricture. When it has been practicable the result has not been permanently satisfactory the stricture recontracting and the fistula again appearing

Several methods of transplantation of the ureter have been tried. Exposure of the upper end of the ureter and implantation into the bladder should be attempted. The author has had a number of successful cases.

Implantation into the cæcum or sigmoid has been practised, with an operative mortality of 58 per cent. in bilateral implantation, and of [redacted] per cent. in unilateral implantation. Death usually occurs within a short time from ascending pyelonephritis.

Plastic operations on the vagina and obliteration of the vagina have been successful in a few cases.

Nephrectomy should only be done after other methods have failed.

STONE

The great majority of stones found in the ureter have been formed in the renal pelvis. Rarely a calculus forms around a foreign body such as a silk stitch (Fig 549 3) Impaction usually takes place at the outlet of the renal pelvis, at the entrance of the ureter into the bladder or at the level of the brim of the bony pelvis. In rare cases the position of the calculus varies with the attitude of the patient.

There is usually only one calculus (90 per cent.) but there may be two three, or as many as twenty-seven. Ureteral calculi are bilateral in only 3·6 per cent. of cases.

In shape they resemble a date or a coffee-bean. When large they may be round or sausage-shaped Ureteral calculi weighing 816 gr (Bloch) 803 gr (Carless) and 780 gr (Federoff) have been recorded. The surface may be smooth, bossy or spiculated. (Fig 549) There is frequently a stricture below the point of impaction. In old-standing cases the ureter above the calculus is dilated, and the kidney hydronephrotic There are calculi in the corresponding kidney in 13 per cent. of cases. Pyonephrosis may be found sclerosis and atrophy of the kidney are rare.

Symptoms.—When the calculus passes along the ureter there is an attack of renal colic repeated at frequent or at long intervals. The pain may commence at a spot in the line of the ureter lower than the kidney and it may remain fixed at this spot. There may also be fixed, dull aching pain over some part of the ureter This pain is aggravated by movement or straining, or on taking diuretics. The attacks of colic may be frequent and severe till the calculus is expelled

fibrous tissue. Nephrectomy may be required for septic complications, or for the cure of intractable fistula.

2. Surgical Wounds

Injury to the ureter is occasionally caused by forceps during delivery but more frequently occurs during pelvic operations, especially on the ovaries and uterus. It may be partly or completely cut, or its wall or blood supply damaged, so that it sloughs and a fistula forms after some days. The fistula may open in the vagina or in the cervix, if a subtotal excision of the uterus has been performed, or it may open at the abdominal wound.

Treatment.—When the ureter has been partly cut or lacerated the edges of the wound should be sutured with fine catgut.

A covering of areolar tissue or even of peritoneum greatly assists healing of the ureteral wound. An irregular tear or a complete laceration is better treated by resection of a portion of the tube, followed by anastomosis by one of the following methods:—

1. End to-end anastomosis.
2. End to-end anastomosis with invagination.
3. End to-side anastomosis with or without invagination.
4. Lateral anastomosis.

When a portion of the ureter has been torn away one of the following procedures may be carried out:—

1. Implantation of the upper part of the ureter into the bladder (uretero cystoneostomy).
2. Uretero-ureteral anastomosis, the torn ureter being grafted with the sound ureter
3. Formation of a cutaneous fistula.
4. Implantation into the intestine.
5. Immediate nephrectomy

Nephrectomy should, if possible, be avoided; cystitis is frequently present, and thus there is danger of ascending pyelonephritis of the remaining kidney

Results.—In 60 cases of ureteral anastomosis there were 43 complete ecoveries, 9 recoveries after temporary fistula, and 8 deaths (Alkane).

FISTULA

Fistula of the ureter may be cutaneous or vaginal and may be congenital, or result from surgical operation, or follow parturition. On the vesical side of the fistula there is usually stenosis of the ureter and *above the fistula the ureter and kidney are frequently* dilated. Infection of the fistula, ureter and kidney invariably occurs.

When the ureter is completely severed, cystoscopy shows no movement at the ureteric orifice, but in partial division rhythmic contraction is observed. Methylene-blue solution injected into the bladder will escape by the fistula if it communicates directly with the bladder but does not escape when the ureter only is affected. It is sometimes difficult to ascertain which ureter is fistulous. This information is obtained by cystoscopy when the orifice of the affected ureter is motionless and without efflux, and the subcutaneous injection of indigo-carmine is followed by a coloured efflux from the healthy ureter and none from the fistulous ureter

Examination.—There may be tenderness over the impacted calculus if the stone is at the lower end of the ureter it may be felt per rectum or per vaginam. On cystoscopy the ureteric orifice is unaltered, or shows surrounding congestion and thick and gaping lips sometimes it is puckered and surrounded by heaped up velvety mucous membrane or by œdematous bullæ. Occasionally the trigone is hidden by œdematous mucous membrane A stone impacted in the intra mural portion of the ureter is seen as a red swelling outside and above the ureteric orifice its brown or white tip may project from the opening

The efflux may be rapid and forceful and may be tinged with blood or cloudy with pus. If a stone be impacted low down, the movements of the orifice are often slow and the efflux is discharged feebly

The ureter may be sounded by means of a ureteral catheter or a solid bougie In female subjects Kelly has used wax-tipped bougies which show scratches on the wax when a calculus is present

Radiography is the most reliable method of diagnosis. Stones as small as a split pea or even smaller can be demonstrated. Very minute calculi may be overlooked and pure uric-acid calculi, which are rare do not throw a shadow The diagnosis of small stone shadows may be confused by the shadows of the vertebral transverse processes, the sacrum, ischial spine and the horizontal ramus of the pubes, or by calcified lymph-glands, calcified appendices epiploicæ, opaque bodies in the appendix, atheromatous arteries, phleboliths, calcareous deposits in old scars or chronic inflammatory tissue or on ligatures, calcareous deposits in the seminal vesicles, intestinal contents (Blaud's pills, bismuth-covered fæces, etc.) or enteroliths A differential diagnosis is made by the position of the shadow the shape number and clinical history In doubtful cases stereoscopic radiograms should be taken after passing an opaque bougie up the ureter

1 **Diuretic treatment.**—If small stones have recently passed into the ureter with recurring attacks of renal colic and especially if a calculus has previously been passed, diuretics such as potassium citrate and acetate, theocin sodium acetate Contrexéville Evian or Vittel water should be administered, together with antispasmodics such as atropine or belladonna

The treatment should be limited to four or six months When dilatation of the kidney is commencing (as shown by pyelography) operation should be undertaken without delay

2. **Instrumental treatment.**—The ureter and especially its narrow orifice, may be dilated by graduated bougies passed through an operating cystoscope The calculus may at the same time be dislodged from its position of impaction. Dilatation is followed by a vigorous course of diuretic treatment, and antispasmodics (belladonna

into the bladder The patient frequently feels something drop into the bladder and the pain ceases. After some hours or days the calculus is discharged from the urethra.

At the upper part of the ureter the symptoms are rarely distinguishable from those of calculus in the renal pelvis. When the stone lies just outside or in the wall of the bladder symptoms of bladder irritation become prominent and there is pain along the urethra to the end of the penis. Genital symptoms also appear such as painful emissions,

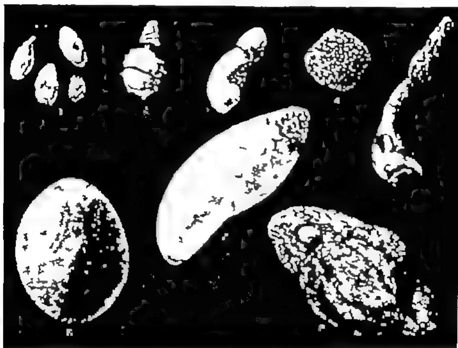


Fig 649—Collection of ureteric calculi.

1, Calculi passed after temporary impaction, 2, calculus impacted at ureteric orifice, mushroom-shaped portion in bladder 3, calculi formed on silk sutures 4–6, impacted calculi removed by operation.

hæmospermia and testicular pain, and there may be constant pain in the rectum aggravated by defæcation. Hæmaturia may be severe and usually follows renal colic During an attack of colic there may be oliguria or temporary anuria and under certain conditions calculous anuria becomes established.

Pus, bacteria crystals and tube-casts may be present and phosphaturia is sometimes observed.

The complications that may occur are calculous anuria infection (usually hæmatogenous) and chronic obstruction. As a result of infection pyelonephritis or pyonephrosis may develop and as a result of obstruction, hydronephrosis.

Examination.—There may be tenderness over the impacted calculus if the stone is at the lower end of the ureter it may be felt per rectum or per vaginam On cystoscopy the ureteric orifice is unaltered, or shows surrounding congestion and thick and gaping lips sometimes it is puckered and surrounded by heaped up velvety mucous membrane or by œdematous bullæ. Occasionally the trigone is hidden by œdematous mucous membrane A stone impacted in the intramural portion of the ureter is seen as a red swelling outside and above the ureteric orifice its brown or white tip may project from the opening

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morphia) are administered. A special ureteric catheter with a distensible balloon, and the injection of oil and eucaine or novocain into the ureter have been used in special cases.

3 **Operative treatment.**—This is indicated—(1) in calculous anuria, (2) where medicinal and instrumental treatment has failed, (3) where infection has occurred, (4) where dilatation of the kidney is commencing.

A calculus situated in the lumbar segment of the ureter is exposed *by an oblique lumbar incision one impacted at the pelvic brim may* be reached by a curved incision beginning at the level of the anterior superior iliac spine, and passing downwards and inwards parallel to Poupart's ligament and about 2 in. above it. The peritoneum is raised and the ureter is found adhering to it. A calculus arrested in the pelvic portion of the ureter may be removed by the same route. The best approach to the ureter at or below the brim of the pelvis is by a median suprapubic incision. The patient is placed in the Trendelenburg position, and the peritoneum stripped from the bladder and lateral wall of the pelvis and iliac fossa. The ureter is thus freely exposed. An inguinal hernia causes difficulty The stone is usually felt, and if easily accessible is cut upon directly If it is difficult to reach, the ureter is opened in an accessible position and the author's scoop or forceps passed down and the stone drawn up The ureter is sounded for stricture, and two or three fine catgut stitches are placed in the ureter and a covering of fat applied. A drainage-tube is inserted down to the ureter and the abdominal wall repaired. The advantages of this method are ease of access and ready drainage.

Transperitoneal removal of ureteral calculi is very rarely practised, and the vaginal route has been abandoned.

A calculus in the intramural portion of the ureter can sometimes be dislodged by ureteric bougies or other intravesical manipulation. If this fails, it is removed from within the bladder after suprapubic cystotomy In all cases stricture of the ureter should be sought and treated.

Results—Excluding cases of calculous anuria, extraperitoneal ureterolithotomy has an operative mortality of 5·5 per cent. Recurrence is rare.

THE BLADDER

Anatomy—The bladder normally holds 8 to 10 oz. In moderate distension about 1½ in. of the anterior wall of the viscus above the symphysis pubis is uncovered by peritoneum. In front of the bladder, behind the pubic symphysis, is the space of Retzius, filled with areolar tissue. The internal meatus of the urethra is on a level with the middle of the symphysis pubis and about 2 cm. behind it. This is the most fixed part of the bladder The base in the male is in relation to the prostate, which underlies the anterior

half of the trigone and behind this lie the seminal vesicles, above which is the peritoneum of the recto-vesical pouch.

In the female bladder the base is in relation to the anterior vaginal wall, to which it is adherent. The anterior fornix of the vagina is in relation to the bladder for about 1 in. behind the base of the trigone and behind this the anterior surface of the uterus lies upon the posterior wall of the bladder almost to the apex. At the apex of the bladder the peritoneum covers it for a short distance before being reflected on to the uterus. In the child, about one half of the bladder lies above the pubic symphysis (Symington). The anterior surface is entirely uncovered, and the posterior completely covered by peritoneum.

The trigone of the bladder is a structure distinct from the rest of the organ, and the muscular fibres are derived from the internal longitudinal layers of the ureters, which unite to form the interureteric bar of Mercier and also pass forwards to the internal meatus, interlacing to form a thick muscular layer and passing into the internal longitudinal muscular layer of the urethra.

The bladder sphincter consists of non-striped muscle-fibres continuous with the muscle of the trigone lying on the upper surface of the prostate.

The mucous membrane is composed of transitional epithelium, and there are no papillæ. The mucous membrane of the trigone is thick and adherent, that over the rest of the bladder thinner and freely movable.

The lymphatics from the anterior surface pass to glands along the external iliac vessels, those of the upper part of the bladder pass to the external iliac and hypogastric glands, and those of the lower part and posterior wall pass to the sacral ganglia at the bifurcation of the aorta.

The nerve supply is derived from the 2nd, 3rd, and 4th sacral nerves. The sympathetic nerves are derived from the hypogastric and hæmorrhoidal plexuses. The lowest reflex centre for the bladder is contained in these sympathetic plexuses.

Examination.—A greatly distended bladder forms a prominent rounded suprapubic swelling, which can be felt as a smooth, round, elastic mass, and is dull on percussion.

On rectal examination about 1½ in. of the bladder base just behind the trigone can be felt above the prostate, and a bimanual examination can be made with the other hand above the pubes. A distended bladder forms a soft cushion which tends to bury the prostate. The infiltration of a malignant growth at the base of the bladder may be detected in this situation.

On vaginal examination the short urethra can be felt in the anterior vaginal wall, and the trigone of the bladder can sometimes be defined. Behind this the bladder base can be palpated from the anterior fornix.

Examination by catheters and sounds.—The passage of a catheter is required to withdraw the urine in vesical atony or urethral obstruction, to ascertain the presence and quantity of residual urine, or to obtain an uncontaminated specimen of urine from the bladder. A calculus is sometimes felt on passing a catheter and a portion of growth may be caught in the eye of a catheter.

The most stringent antiseptic precautions must be used in passing instruments into the bladder. The method of passing instruments is described at p. 938.

For sounding the bladder the organ should contain 6–8 oz. of fluid. The stone sound is introduced in the same way as a metal catheter and when the beak engages in the prostatic urethra the handle is fully depressed between the thighs and then pushed onwards so that the beak rides over the posterior

lip of the internal meatus. The bladder should be systematically searched by turning the handle *from side to side while slowly withdrawing.*

Exploration by operation.—When necessary the bladder may be opened suprapubically and the patient placed in the Trendelenburg position. With bladder retractors and the help of a head lamp the interior of the bladder can be thoroughly searched.

The perineal route in the male and the urethral and vaginal routes in the female are unsatisfactory and inadequate methods of exploration.

Radiography is discussed elsewhere (Vol. I. p. 666).

Cystoscopy.—There are two methods of cystoscopy—(1) indirect, (2) direct.

1. *Indirect cystoscopy*.—This is carried out by means of a cystoscope after distension of the bladder with fluid. The various forms of cystoscope are described in special works on the subject. For routine use an "irrigation" cystoscope is most useful. This consists of a hollow tube with an angled beak which carries a small electric lamp. At the proximal end of the tube there is a valve which prevents the escape of the fluid until required. A telescope with a prism and lenses fits the interior of the tube and is slipped in after the bladder is washed and distended. The patient lies on a couch with a sand pillow beneath the pelvis, or sits in a special chair with the knees and hips flexed and the thighs widely apart. The urethra is anæsthetized by instilling 20 minims of a 5-per-cent. solution of novocain into the prostatic urethra by means of a Guyon's syringe. The catheter portion of the cystoscope is lubricated with glycerine and introduced, and the bladder filled with 8 oz. of warm boric solution. The telescope is now introduced, the light switched on, and the window turned to the base of the bladder. Careful and prolonged washing may be necessary to obtain a clear medium when hæmaturia or pyuria is present, and a weak solution of silver nitrate (1 : 10 000) or a small quantity of adrenalin may be used in order to stop oozing. The bladder is examined systematically. The trigone is first inspected with the window facing downwards in the middle line. The instrument is then rotated an eighth of a circle to the right and to the left, and the ureters come into view. The appearance of the ureteric orifices, their movements, and the quantity and colour of the efflux are noted. In turn, the base of the bladder, the lateral and posterior walls, and the apex are inspected. Full depression of the ocular end of the cystoscope is required to demonstrate the posterior wall, and a small air bubble marks the apex. The anterior wall and the internal meatus are then examined.

2. *Direct cystoscopy*.—This method was perfected by Kelly and has been modified by Luys and others. Kelly's specula are used for women only and are plated metal cylinders 3½ in. long with a funnel-shaped expansion and a handle at the outer end. The instrument is introduced with an obturator after dilatation of the urethra. General anæsthesia may be necessary. The patient is placed in the knee-chest position, the speculum is introduced and the obturator withdrawn. Air rushes in and distends the bladder, and light is projected through the tube from a head lamp. Luys has modified this method and uses it in the male also. His instrument consists of a metal tube 10 cm. long for female, and 18 cm. for male subjects. The patient is placed in the Trendelenburg position, with local or general anæsthesia.

The direct methods are inferior to the indirect where examination only is desired. There is frequently difficulty in obtaining the proper distension of the bladder with the atmospheric pressure, and the position of the patient is irksome and embarrassing. Urine tends to collect in the bladder during

the examination, and must be removed with a suction apparatus. Where applications to the interior of the bladder are necessary or foreign bodies have to be removed, the direct methods are invaluable

The methods of collecting urine from each kidney have already been considered (p. 818). The tests of the function of each kidney should be used (p. 817).

INCONTINENCE OF URINE

Incontinence of urine may be false or true.

In *false incontinence* the bladder is full, as in chronic retention from prostatic or urethral obstruction and the escape is the over flow from the distended organ.

In *true incontinence* the bladder is not distended Of this there are two types, passive and active. In the *passive* type the sphincter is paralysed and the urine dribbles away without distending the bladder and without the assistance of contraction of the bladder In the *active* type the urine is expelled by contraction of the bladder Here there is sphincter action but it is either too weak to resist normal contractions of the bladder or the contractions are so strong as to overcome a normal sphincter

Incontinence due to Mechanical Causes

This occurs more frequently in women than in men. It may be observed in a very slight degree on exertion in otherwise normal individuals. Parturition is a frequent cause In older women in continence occurs in combination with cystocele. Forcible dilata tion of the urethra for digital examination of the bladder was at one time a frequent cause of incontinence in women. In men perineal prostatectomy or the perineal drainage of the prostatic cavity after suprapubic prostatectomy may cause incontinence and it also occurs as a result of some extensive war injuries to the bladder and perineum.

Treatment.—In slight cases strychnine and ergot should be given. The use of a vaginal pessary is of service. A cystocele should be excised.

For urethral dilatation in the female, Duret has transplanted the urethra forwards to the neighbourhood of the clitoris, and Gersuny operates by dissecting up the urethra and twisting it on its long axis Paraffin has been injected around the urethra and vesical orifice in incontinence of urine in the female. If treatment fails a urinal must be worn.

In war injuries in the male it has been found that (apart from nerve injuries) continence has eventually been re-established. For postoperative incontinence in perineal prostatectomy Young has introduced a plastic operation.

Incontinence due to Nervous Disease

Incontinence occurs in organic diseases of the spinal cord. In some cases there is false incontinence (i.e. chronic distension and overflow) especially in the early stages of the bladder affections of tabes. After a time the bladder regains some of its contractile power the residual urine is reduced to 8 or 10 oz., and the patient can expel the rest voluntarily Incontinence in these cases is first noticed at night bed wetting which develops in adult life without other symptoms should lead to a careful examination of the central nervous system.

In multiple sclerosis a different type of incontinence is met with, the bladder being contracted and urine spasmodically ejected without control.

Treatment.—The over distended bladder should be slowly emptied by the catheter at regular intervals under the strictest aseptic precautions. If there is complete retention this should be done three times in twenty four hours. The bladder should be washed with silver-nitrate solution (1 10 000) *if any sign of infection is observed* Urinary antiseptics (hexamine etc) are combined with strychnine and ergot, and the bowels carefully regulated. For continual incontinence a urinal must be worn.

Incontinence due to Nerve Injury

The author has shown that injury to the spinal cord (fracture dislocation or gun-shot injury of the spine) above the lumbar centre is followed by a period of complete retention with overflow (false incontinence) which lasts for a varying period, usually about two months. This is followed by a period of active incontinence. *Involuntary micturition occurs at regular intervals. The length of* time between the acts of micturition depends upon the presence and severity of cystitis. The bladder function is similar to that in the infant, where no cerebral control exists.

If recovery from the nerve injury does not take place, the periodic active incontinence continues. Partial or complete recovery of voluntary micturition may occur depending upon the nature and severity of the lesion.

Lesions of the lumbar centres, cauda equina, or hæmorrhoidal sympathetic nerve plexus (in excision of the rectum) are followed by complete retention with overflow Partial recovery may take place as this voluntary micturition is partly re-established, *and there* is a varying amount of residual urine.

The chief danger in nerve injuries affecting the bladder is ascending pyelonephritis (surgical kidney) from septic catheterization.

Treatment.—The treatment of the nerve injury belongs to

general surgery In civil life if it is possible to carry out aseptic catheterization, this should be done regularly In war and sometimes in civil life this is not possible, and suprapubic cystotomy should be performed and the bladder drained until the first period of complete retention is over The bladder wound may then be closed and the patient provided with a urinal. When partial or complete retention is present aseptic catheterization at regular intervals should be carried out.

Incontinence due to Bladder Spasm

In multiple sclerosis, incontinence is due to spasm In acute inflammation of the bladder and prostatic urethra, uncontrollable spasm may cause active incontinence. This is usually nocturnal. Tuberculosis of the bladder is a frequent cause

Treatment.—In acute cases hot fomentations should be applied suprapubically and on the perineum, morphia and belladonna suppositories used, and a hot-water enema to which 30 gr of antipyrin have been added, given.

Contrexéville or Vittel water and sandalwood oil may be administered, and hot sitz-baths are useful. In chronic cases diuretics and sandalwood, belladonna and hyoscyamus and small doses of opium should be given, and the cystitis simultaneously treated. In tuberculous cystitis the bladder should not be washed.

Incontinence of Childhood—Nocturnal Enuresis—Essential Enuresis

Up to the end of the first year the bladder acts automatically About that time mental control by inhibition of the act of micturition begins, and by the end of eighteen months, or at most two years, it is fairly established, although there may still be occasional lapses up to the age of 3 years. After that age constant or frequent bed wetting must be regarded as abnormal. The onset of enuresis is usually observed between the ages of 5 and 8, but the nocturnal control may never have been established. Enuresis is usually nocturnal, sometimes it is also diurnal, rarely it is diurnal only Boys and girls are equally affected.

Etiology.—In certain cases some source of irritation is present such as thread worms, anal fissure, vulvitis, phimosis, and balanitis, and the incontinence is looked upon as reflex. Enlarged tonsils and adenoids are present in some cases, and enuresis is said to be due to partial asphyxia during sleep

In other cases there is some abnormality in the urine or bladder such as highly acid urine, uric-acid crystals, phosphaturia, bacilluria, cystitis, vesical calculus, or tuberculous cystitis. In some cases no

source of irritation, no alteration in the urine or disease of the bladder can be found. These cases are called essential enuresis. In these children there is frequently an heredity of nervous disease such as epilepsy neurasthenia, alcoholism insanity etc. The child may be nervous quiet, sensitive and furtive and often suffers from stuttering and habit spasms. The enuresis is always worse after excitement In a small number of cases the enuresis occurs during a minor epileptic attack.

Prognosis.—Where some abnormality amenable to treatment is found, the prognosis is good. In the majority of cases of essential enuresis continence becomes complete with or before the advent of puberty Most cases get well under treatment, but in a small percentage the enuresis persists, sometimes into adult life.

Treatment.—All sources of irritation, such as thread worms, phimosis, or anal fissure, hyperacid urine, phosphaturia, bacilluria, cystitis, stone, etc should receive appropriate treatment.

When no source of irritation is found treatment along the following lines is indicated Mental excitement and late hours should be avoided and sometimes even school and lessons temporarily stopped. The principal meal should be at midday and fluids prohibited after five o clock. Tea, coffee ginger beer and ginger ale highly seasoned foods sugar and pastry should be avoided and meat taken only in moderation. The child is trained to hold water as long as possible during the day and to empty the bladder before bedtime. He should be wakened to micturate after about one and a half hours sleep Belladonna is given in doses suitable to the patient s age and idiosyncrasy In a child of 5 years or over the dose should commence with 8 minims of the tincture, and slowly increase up to 30 or 40 minims three times a day unless symptoms of poisoning appear If the enuresis is controlled the dose is kept a little beyond the point of control for a fortnight and then gradually reduced. Tincture of lycopodium may be combined with belladonna. Nux vomica and ergot in small doses are sometimes useful, and potassium bromide, antipyrin and fluid extract of *Rhus aromatica* have been recommended.

Local treatment should, if possible, be avoided but it is successful in some cases where other methods have failed. This consists in the instillation into the prostatic urethra of nitrate of silver (1 per cent.) or treatment with the continuous current applied by means of a urethral electrode.

Cathelin has suggested the injection of fluid into the sacral canal with the object of causing pressure on the sacral nerves. He claims 80 per cent. of cures, but the treatment has not been so successful in other hands.

RETENTION OF URINE

Etiology.—The causes of retention of urine may be classified as follows.—

1. **Retention with obstruction** (*a*) *Prostate*.—(1) Simple enlargement (2) malignant disease (3) stone (4) acute prostatitis and prostatic abscess. (*b*) *Urethra*.—(1) Rupture of urethra (2) acute urethritis, (3) stricture (4) stone and foreign bodies (5) pressure from without pelvic tumours, etc.

2. **Retention due to atony**.—(*a*) With symptoms of nervous disease tabes and other spinal lesions (*b*) Without symptoms of nervous disease idiopathic atony

3. **Retention in acute and chronic intoxications**.—Typhoid appendicitis salpingitis arsenical mercurial belladonna or lead poisoning, and syphilis.

4. **Retention from inhibition or spasm**.—Hysterical retention retention after anal and rectal operations.

Symptoms.—Retention of urine may be acute or chronic.

Chronic retention.—This is always incomplete and the amount of urine remaining in the bladder varies from a few ounces to several pints The condition is found in cases of enlargement of the prostate and in certain diseases and injuries of the spinal cord Where the quantity retained is large, the distended bladder is found on palpation of the abdomen where it is small nothing is found but after the patient has passed water the catheter withdraws several ounces of urine. In chronic retention there is frequency of micturition and often nocturnal incontinence. Pain is absent, and the patient may be unaware of the presence of the distended bladder Symptoms of uremia from back pressure on the kidneys are often present, such as headache, thirst, dry glazed tongue, loss of appetite, sallow complexion, and loss of weight

Acute retention.—There is a history of gradually increasing difficulty or sudden retention. The retention is complete. The patient suffers from frequently recurring painful spasms of the bladder The tense distended bladder can be felt and the palpation may initiate a spasm.

Diagnosis.—It is necessary to distinguish between anuria and retention and between atonic and obstructive retention. In obstructive retention the form of obstruction must be ascertained.

In anuria there have been previous signs of renal disease but no symptoms of disease of the bladder or urethra There is no pain no distension of the bladder and an instrument passes easily into the bladder but draws no urine. In retention of urine there is usually a history of increasing difficulty of micturition and other

signs of obstruction. Symptoms of renal disease are absent or insignificant The bladder is distended.

In retention due to atony there is no pain and no desire to micturate. In obstructive retention there are recurrent spasmodic attempts to empty the bladder these are sometimes absent in old men.

A large-sized instrument enters the bladder easily if retention is due to atony but is arrested if retention is due to obstruction the presence of signs of spinal disease clinches the diagnosis.

In young men the most frequent cause of acute retention is gonorrhœa, and there is a history of an acute discharge. In adult life retention is usually due to stricture, and there is a history of gradually increasing difficulty of micturition culminating in complete retention after alcoholic excess or exposure to cold. The passage of an instrument confirms the diagnosis.

In old men enlargement of the prostate is the most frequent cause of retention. There is a history of nocturnal frequency and increasing difficulty and rectal examination shows that the prostate is enlarged.

Treatment.—The following is the treatment suitable to the chief types —

1 *Acute inflammation of the urethra (gonorrhœa, etc.)* —Every means should be tried to relieve the retention without the passage of a catheter A hot bath or sitz bath, followed by a rectal injection of hot water and a suppository containing belladonna and opium, should be given. If relief is not obtained in half to three-quarters of an hour an anæsthetic should be given, the urethra thoroughly washed out with potassium permanganate (1 5 000) and then a rubber catheter passed. The bladder should be washed with permanganate or protargol (1 10 000) solution and a little of the solution left in the bladder If acute prostatitis and prostatic abscess is present, early operation is indicated.

2 *Obstruction of the urethra by stone foreign bodies pedunculated bladder growths blood-clot etc* —Relief by catheter should be given without delay Spasm of the compressor muscle may hinder the passage of the catheter and may necessitate the use of several metal sounds before the catheter can be introduced.

If the bladder is distended with blood-clot an attempt may be made with a large metal catheter to break up the clot and wash it out, or a lithotrite may be used and an evacuating cannula. Should these methods fail the bladder must be opened suprapubically the masses of clot removed, and a large rubber drain inserted.

3. The *distended atonic bladder of spinal disease* should be regularly catheterized with the same precautions as in enlarged prostate.

4 *Retention from reflex spasm after operations and retention due to*

hysteria.—In operation cases the catheter is passed without delay In other cases hot baths and other means of relieving spasm (see Acute Inflammation, p 894) should first be tried A metal catheter is the best instrument for these cases.

5. *Retention with enlarged prostate.*—The preliminary measures detailed above may be tried but recourse to the catheter will nearly always be necessary The following points are of the utmost importance —

i. The most rigid asepsis must be practised
ii The delicate handling of instruments is essential.
iii. All the urine of an over-distended bladder must not be withdrawn at once, or must be drawn off very slowly

Coudé and bicoudé catheters are most suitable When obstruction is felt the greatest gentleness is exercised sometimes twisting to one side or another or withdrawing a little and pushing on, will be successful. In cases of enlarged prostate the urethra is greatly elongated, and may require deep insertion of a metal prostatic catheter with a large curve and a long beak a gum-elastic catheter bent into a full curve or into some other shape may be successful when other catheters have failed. A long curved metal stilet is useful to maintain the curve of a gum-elastic catheter After introduction of the catheter the stilet is withdrawn and the catheter left in position.

These methods failing, suprapubic puncture will be necessary (see p 896).

The vesical or renal hæmorrhage or the suppression that may follow sudden emptying of an over-distended bladder is avoided by keeping the patient warm in bed, and by drawing off only 10 or 15 oz. at intervals of half an hour until the bladder is empty Another method is to tie in a catheter of very fine calibre and allow the urine to dribble slowly away When the bladder is empty a few syringefuls of silver-nitrate solution (1 10,000) should be injected and allowed to escape, and the catheter tied in. Stimulants and diuretics and urinary antiseptics (hexamine, salol) should be given.

After several days of continuous bladder drainage the decision will have to be made as to whether "catheter life is to be commenced or an operation performed.

6. *Retention with stricture.*—A hot sitz-bath and rectal injections followed by a suppository of morphia (¼ gr) should be tried. This failing, a catheter should be passed, preceded by a No 7 or 8 French bougie if necessary When a filiform bougie only will pass, it should be tied in place. After half an hour the urine begins to trickle alongside the bougie a few hours later a larger instrument, and eventually a catheter can be introduced

A more rapid method is to use a metal catheter with a conical end which screws on to a filiform bougie. The bougie acts as a guide, and the catheter is forced through the stricture. Harrison's whip bougies are useful, especially if laterally grooved to facilitate escape of urine. There is less danger of completely emptying a distended bladder in a case of stricture than in enlarged prostate.

If instruments fail the bladder must be emptied by *suprapubic puncture* an inch above the upper margin of the pubic symphysis in the middle line. The skin is incised, and then the aspirating needle introduced. There is little risk of injuring the peritoneum when the bladder is distended and the percussion note dull. The aspirating needle should not be large lest leakage at the point of puncture of the bladder take place. There is a danger of prevesical abscess if the urine is septic. Usually after a single aspiration an instrument can be introduced through the stricture and tied in, but in rare instances the puncture must be repeated.

Operation for the relief of the stricture should be performed as soon as possible.

EXTROVERSION

In this rare condition the anterior vesical wall is congenitally absent, so that the mucous membrane is exposed and the urine discharged on the surface. Male infants are more frequently affected than female.

At birth there is a dark red, plum-sized suprapubic swelling. The mucous membrane becomes folded, irregular and excoriated; at its margin there is a zone of scar tissue with irregular epithelial ingrowths into the mucosa. The umbilicus may be normal and separated from the open bladder by healthy skin, or the bladder may fill the entire space from the umbilicus to the root of the penis. The ureters, which are frequently dilated, open on two nipples close together and the trigone is undeveloped. The penis is undeveloped and epispadiac; at its base in a small pocket are the sinus pocularis and ejaculatory ducts. The foreskin is well developed in the form of an apron. The scrotum is split or rudimentary and rarely contains the testicles, which are retained in the abdomen or lie in the groin. The prostate is absent or rudimentary. The pubic bones do not unite in the middle line, and may be separated by 3 in. or more. Associated deformities, such as hare-lip, cleft palate, and spina bifida, are sometimes observed. The perineal muscles may be defective, and the anal sphincter ill developed. Less extensive degrees of this maldevelopment may be observed. The condition is ascribed either to an arrest of development or to an intra-uterine rupture of the bladder following obstruction.

Symptoms and prognosis.—The conditions of existence are extremely miserable. There is constant escape of urine, saturating the clothes and leading to inflammation and excoriation of the skin. The mortality from ascending pyelonephritis is very high, but occasionally the patients attain adult life and even old age.

Treatment.—Of the many operations suggested, the following are the chief types:—

I. Formation of a reservoir in the body

A. From the bladder

i. Closure of the defect by osteoplastic operation (Trendelenburg).

ii. Closure of the defect by flaps.

(a) Autoplastic methods, using skin (Woods) or intestine.

(b) Heteroplastic methods.

B. From the rectum.

i. By transplantation of the ureters.

ii. By vesico-rectal fistula.

C. From the sigmoid flexure.

D. From the vagina.

II. No reservoir formed in the body

i. Implantation of ureters (a) in the urethra (Sonnenberg), (b) in the skin.

ii. Nephrostomy

The operation that has given the most successful results is transplantation of ureters and trigone into the sigmoid flexure by Maydl's method. The danger of ascending pyelonephritis is much reduced by retaining the sphincter action of the bladder base. Peritonitis and fistula are also dangers. The immediate mortality of this operation varies from 5·5 to 26·7 per cent. Soubottine's operation consists in making a fistula between the bladder and the rectum. By a horseshoe incision surrounding the rectal aspect of the fistula an area of rectum is marked out, and this is folded so as to form a small bladder, the lower open end of which is controlled by the anal sphincter. The suprapubic gap in the anterior bladder wall is then closed.

DIVERTICULA

A diverticulum is a pouch lined with vesical mucous membrane surrounded by fibrous tissue, coarse fat and often some non-striped muscle and communicating with the bladder by a narrow opening. Diverticula are said to be congenital and acquired the former having a muscular wall, and muscular tissue being absent in the latter. Diverticula should be distinguished from the pouches or saccules of a sacculated bladder commonly seen in prostatic obstruction. They are single or multiple, small as a pea, or as large as or larger than the bladder cavity. Small diverticula are frequently multiple. The orifice has sharply defined edges, may admit a crow-quill or the point of the forefinger and frequently is surrounded by trabeculation. The ureteric orifice sometimes opens in the wall of the diverticulum or close to its orifice. (Fig. 550.)

Diverticula are most frequently found in the lateral walls or on the posterior wall. Rarely they open on the trigone. They may occur in infants, but are most frequently found in male adult life. Prostatic or urethral obstruction is found in a few cases, but is usually absent.

Symptoms.—The symptoms are usually puzzling and irregular. There may be apparently causeless attacks of frequent micturition at varying intervals or almost continuously or recurrent attacks of difficulty and retention of urine.

Symptoms are sometimes entirely absent, and the diverticulum is discovered accidentally. Micturition in two parts may be present in large diverticula. Sometimes the second supply is purulent when the first is clear. On passing a catheter the bladder is apparently emptied when the point of the catheter slips onwards and a large quantity of urine is passed. The edge of the diverticulum may sometimes be felt with a sound. A large

diverticulum can be felt as a tumour in the lower part of the abdomen when the bladder is distended. Diagnosis is made with the cystoscope. The dimensions and position of a diverticulum are demonstrated by skiagraphy after distending the bladder with an opaque solution such as sodium bromide or iodide (20 per cent.).

Complications.—These are—(1) dilatation of one or both kidneys, (2) infection, (3) calculus in the diverticulum, (4) malignant growth at or near the opening.

Prognosis and treatment.—The prognosis is grave when infection has taken place or when malignant growth exists. After infection, washing the bladder has little effect on the diverticulum. In the female subject a Kelly's tube may be passed, and a catheter introduced through this into the orifice, and the diverticulum washed out. The following operations have been performed:—

Fig. 580.—Diverticulum of bladder (cystoscopic view)

1. Drainage outside the bladder. This is only applicable to large diverticula, and leads to a permanent urinary fistula.

2. Closure of the orifice of the diverticulum from within the bladder and drainage of the diverticulum outside the bladder.

3. Drainage into the bladder. The walls of the bladder and diverticulum are split upwards or downwards, and the edges stitched together so that the cavity of the diverticulum is thrown into the bladder. This operation does not remove the residual urine, which is the chief danger of the condition.

4. Excision of the sac and repair of the bladder wall. This operation is the most radical, and gives good results. Where the diverticulum lies low in the pelvis and is extensive the excision is very difficult. The bladder is opened and drawn up and to the opposite side, and the peritoneum is stripped from it. The orifice of the diverticulum, which is usually a firm ring, is excised and the bladder wound closed. The diverticulum is then dissected out, care being taken to avoid injury to the ureter vas deferens, seminal vesicles, rectum and internal iliac vessels, to all of which it may be adherent. The bladder and the pelvic cellular tissue are drained.

HERNIA

This is rare, the bladder being found in only 1 per cent. of hernia operations. It is more frequent in men, and in advanced life. The great majority of bladder hernias are inguinal; femoral are less common; and the obturator sciatic, and perineal varieties are very infrequent.

Etiology.—The bladder is thin walled and distended, and the abdominal wall weak. Urethral obstruction, old age, coughing, straining,

present. A firm, rounded, dull swelling appears above the pubes and closely resembles the distended bladder. On passage of a catheter the swelling remains, and on bimanual examination fluctuation can be detected. Hydatid fremitus is rarely elicited. The diagnosis is greatly assisted by the "complement-fixation" reaction. The cyst is opened suprapubically and the contents are completely removed. The cavity is drained if septic, and closed if not.

INJURIES

Rupture

This may involve the inner coat alone, but generally it is complete. Fully 90 per cent. of cases occur in male subjects, and usually between the ages of 20 and 40. The bladder is invariably distended at the time of the rupture. A considerable proportion of ruptures occur during alcoholic intoxication, and follow kicks, blows, or crushes. In fracture of the pelvis a splinter of bone may penetrate the bladder. Rupture may also result from indirect violence, such as falls from a height, muscular effort or straining, and it has followed the forcible injection of fluid into a diseased bladder. Spontaneous rupture has occurred in an ulcerated or cancerous bladder.

Pathology.—The rent is most frequently situated on the postero-superior wall and opens the peritoneal cavity. Extraperitoneal rupture is less common, and affects the anterior or lateral walls. Rupture of the base or lateral walls usually results from fracture of the pelvis, but has been observed without fracture. The rupture is single and usually small in size, with clear-cut or bruised margins. When the rupture is intraperitoneal the urine escapes into the peritoneal cavity and general peritonitis supervenes. Aseptic urine does not necessarily cause peritonitis, although it is toxic when absorbed. The urine very readily becomes infected, usually from the passage of instruments. In extraperitoneal rupture the urine infiltrates the cellular planes and suppuration follows.

Clinical features.—Shock is present and may be severe, but occasionally it is absent and symptoms are delayed.

There are pain, urgent desire to micturate and straining, but inability to pass water. The abdomen is rigid and tender: there is no dullness corresponding to a distended bladder and the patient has not passed water for several hours. On passage of a catheter a little bloody urine is withdrawn. Rarely the catheter passes through the rent, and a large quantity of urine is obtained. If a catheter is passed several times the quantity of urine is always the same and if the patient is set upright after withdrawal of the urine a large quantity can be obtained, although immediately before this the bladder had been emptied. When the rupture is *extraperitoneal*, dullness appears above the pubes, and there is tenderness and rigidity.

Infiltration spreads in the pelvis and escapes by the sciatic notch

usually intraperitoneal, rarely extraperitoneal. Bladder wo
war are usually complicated by injury to the bony pelvis, re
uterus, vagina, urethra, and intestine.

Foreign bodies—e.g fragments of clothing, pieces of wood
splinters of bone bullets—are frequently carried into the wou
and may be found in the bladder and infection is constant.

Symptoms.—Shock is usually present, and may be profou
There are pain, tenesmus, frequent desire but inability to pass wat
a few drops of blood may be passed after much straining Uri
mixed with blood may escape from the wound, but this may be pr
vented by a coil of small intestine plugging the wound or by the fl
of the urine into the peritoneal cavity There may be profuse
rhage from the wound. When the rectum is injured fæces and flatu
escape from the wound. Spontaneous closure may occur and th
prognosis where collateral injuries are not extensive is relativel
good. Peritonitis may supervene, although it may be delayed unt
the separation of sloughs on the seventh or eighth day

In extraperitoneal wounds there may be comparatively little
reaction and a fistula forms. When the wound is oblique there is
perivesical and periurethral extravasation of urine, which becomes
infected, and this is followed by thrombosis in the vesical and prostatic
veins.

Recto-vesical or vesico-vaginal fistula, or fistula on the surface of
the abdomen scrotum, perineum thighs, or buttocks, is very common

Diagnosis.—The escape of urine from the wound and the presence
of blood in the urine with tenesmus are sufficient to establish the
diagnosis. The intra or extraperitoneal nature of the wound will
usually be decided by operation.

Treatment.—Laparotomy should be performed as soon as
possible when there is a wound of the lower part of the abdomen.
Wounds of the bladder and intestine are searched for and sutured.
An extraperitoneal wound on the anterior surface of the bladder may
be used for draining the bladder or it may be closed and a catheter
tied in the urethra. When the bladder has been wounded from the
perineum the wound should be carefully examined and free drainage
provided. If symptoms of peritonitis supervene the abdomen should
be opened.

An X ray examination should be made whenever possible for
portions of projectiles and fractures of the pelvic bones.

Extensive operations for the removal of missiles or immediate
plastic repair of the bladder should be avoided. Free drainage and
the removal of injured tissues at the time of the injury and subsequent
reparatory operations when the period of sloughing and sepsis has
passed are the soundest line of treatment.

CYSTITIS

Inflammation of the bladder is due to the combination of a bacterial infection with some factor producing lowered resistance Rarely a virulent type of bacteria may alone cause cystitis, but usually some predisposing factor collaborates by producing congestion or injury of the bladder wall or stagnation of the urine the most common are masturbation, affections of the female genital organs pregnancy stricture, enlarged prostate, diverticula, calculus foreign bodies malignant growths, operations upon the bladder atony from nervous disease.

Bacteriology.—Mixed infection is frequent The B coli occurs more frequently than any other bacterium and is often found in pure culture. The following bacteria may also occur alone or in mixed infections, viz. streptococcus, staphylococcus, proteus, gonococcus, pneumococcus of Fränkel and of Friedländer B pyocyaneus, and the typhoid bacillus. In chronic cystitis, anaerobic bacteria are frequently present. The bacteriology varies during the course of either an acute or a chronic attack. The urine is acid in cystitis due to B coli and the gonococcus.

Infection may occur from the kidney by bacteria borne in the urine, or from the urethra by direct spread (gonorrhœa) or by the passage of instruments bacteria may also reach the bladder through a cystotomy wound or a fistula, or by the rupture of an abscess or the formation of a fistula with the bowel.

Pathological anatomy and cystoscopic appearances.—The whole surface of the bladder is seldom involved in acute cystitis. The base is frequently affected alone, or less often, an area of cystitis is situated at the apex or some other part of the organ. Numerous patches may be distributed over the bladder In severe cystitis and in chronic cystitis the whole surface is inflamed.

The capillary vessels are engorged, the mucous membrane becomes reddened, spongy or woolly and the outline of the vessels is obscured. The surface is bright red, and the mucous membrane is thrown into stiff folds and ridges, with shreds of muco-pus or desquamated epithelium adhering to it. Hæmorrhages into the subepithelial tissues may occur. If the hæmorrhages are numerous the condition is known as hæmorrhagic cystitis.

In bullous cystitis the surface is covered with yellow semitransparent bullæ. Small closely grouped granules in the inflamed mucous membrane are characteristic of follicular cystitis. In cystic cystitis there are yellow sago-grain like follicles which are either scattered or grouped together, and may be surrounded by a halo of inflammation. Extensive phosphatic deposit may take place. Necrosis of the superficial layers of mucous membrane mixed with fibrin forms a membrane which is

cast off in the rare condition known as croupous or diphtheritic cystitis. The infection in these cases is usually streptococcal.

In very virulent infections exfoliation of the mucous membrane may take place and the necrosed membrane come away as a cast of the bladder Ulceration is usually confined to the superficial layers, especially along the summits of ridges and folds. Less frequently there is a circumscribed deep round or oval ulcer with a heaped-up sharply cut edge. A spreading ring-like ulcer is rarely observed. Leucoplakia is found in chronic cystitis. In chronic cystitis the submucosa and muscular layers are infiltrated and sclerosed, and the perivesicular fat becomes fibrous adherent, and greatly increased. The bladder contracts and the cavity is permanently diminished. Calculi frequently form in the bladder in chronic cystitis, especially where there are sacculi or residual urine.

Symptoms.—The symptoms are frequent micturition, pain, and changes in the urine In slight cases the urine is passed every two hours and there is some urgency In severe cases a few drops of urine are passed every few minutes, active incontinence may be present and the frequency is as great during the night as during the day Polyuria is often present. There is pain on attempting to hold water and scalding pain in the urethra during micturition In severe cases, cramping pain may radiate from the neck of the bladder down the thighs at the end of micturition. Pyuria is always present. The pus is mixed with mucus and forms a slimy tenacious deposit which clings to the bottom of the receptacle. Blood is present in severe cases and appears at the end of micturition. Severe hæmaturia may occur at the commencement of the attack.

Fever is not a symptom of cystitis. When it is present the rise of temperature is due to renal, prostatic, or extra urinary complications.

Complications.—Retention of urine may occur especially where obstruction (stricture, enlarged prostate) is already present. Ascending infection of the kidneys is a serious and fatal complication. Abscess of the walls of the bladder or in the perivesical tissue may complicate chronic cystitis.

Diagnosis.—1 Vesical symptoms may be caused by extra-urinary conditions such as tabes hæmorrhoids and anal fissure pregnancy ovarian or uterine tumours and prolapse of the uterus. Pyuria is absent in these cases.

2 Urinary conditions other than cystitis may cause frequent micturition, such as the passage of large quantities of urine in diabetes insipidus diabetes mellitus and hysterical polyuria. In highly acid urines, oxaluria and phosphaturia frequent and urgent micturition with pain is often present but pyuria is absent. In enlarged prostate stricture, and urethral polypi frequency of micturition may be present

without cystitis. In certain diseases of the kidney, notably tuberculous disease calculus and pyelitis frequent micturition and pyuria may occur without cystitis.

Is the cystitis primary or secondary? Renal calculus pyonephrosis renal tuberculosis, pyelitis, pyelonephritis, and urethral or prostatic disease may all cause secondary cystitis. The diagnosis is made by the history of the primary infection and the use of the cystoscope the ureteral catheter and the urethroscope

Prognosis.—In uncomplicated cystitis the attack lasts from two to five weeks, and recovery is usually complete When a diverticulum or sacculi of the bladder are present recurrent attacks and eventually chronic cystitis may be expected. When there is urethral obstruction the cystitis rarely disappears until the obstruction is completely removed. Cystitis in a paralysed bladder is permanent When the cystitis is secondary to renal disease it will persist until this is cured.

Treatment. **Acute cystitis.**—The patient is confined to bed and placed on low diet Diuretics are administered, such as Contrexéville water barley water parsley-tea and buchu. When the urine is acid, citrate of potash, potassium bicarbonate magnesium sulphate and liquor potassæ should be given and sandalwood oil added.

To relieve spasm belladonna hyoscyamus, opium and bromide of camphor are given, and hot fomentations applied to the lower abdomen and perineum. Hot sitz-baths are recommended twice or thrice a day and relief may be obtained by means of a hot rectal enema or a vaginal douche containing antipyrin The bowels should be opened with a saline purge.

No attempt should be made to wash the bladder at this stage

Subacute cystitis.—The patient is allowed up and a less restricted diet permitted, but all highly spiced foods curries much meat, coffee and all alcoholic drinks are forbidden.

Urinary antiseptics such as hexamine hetralin, helmitol urodonal, and salol should be administered and sometimes benzoate of soda and boric acid will be found valuable. If the cystitis is due to B coli or other bacteria which flourish in acid urine alkalis should be given but if the urine is alkaline from ammoniacal decomposition, dilute mineral acids, boric acid, benzoate of soda and ammonia and especially sodium acid phosphate are indicated. Bladder washing should be commenced, and vaccine treatment with an autogenous vaccine will be found useful (see below)

Chronic cystitis.—If renal prostatic, or urethral disease is present, this must be treated. The treatment is similar to that of subacute cystitis. Bladder washing plays a prominent part in the

cast off in the rare condition known as croupous or diphtheritic cystitis The infection in these cases is usually streptococcal.

In very virulent infections exfoliation of the mucous membrane may take place and the necrosed membrane come away as a cast of the bladder. Ulceration is usually confined to the superficial layers, especially along the summits of ridges and folds. Less frequently there is a circumscribed deep round or oval ulcer with a heaped up sharply cut edge. A spreading ring-like ulcer is rarely observed. Leucoplakia is found in chronic cystitis. In chronic cystitis the submucosa and muscular layers are infiltrated and sclerosed, and the perivesicular fat becomes fibrous, adherent, and greatly increased. The bladder contracts and the cavity is permanently diminished Calculi frequently form in the bladder in chronic cystitis, especially where there are sacculi or residual urine

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Fever is not a symptom of cystitis. When it is present the rise of temperature is due to renal, prostatic, or extra-urinary complications.

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2. **Cystectomy.**—The ureters must first be transplanted and the bladder removed at a subsequent operation. Implantation into the rectum, large intestine urethra vagina skin of the loin or suprapubic wound, or bilateral nephrostomy has been performed. Implantation into the vagina in the female and into the skin in the male has given the best results. In the male cystectomy is performed by a combined perineo-abdominal method. The posterior surface of the prostate and seminal vesicles is first exposed by a curved prerectal incision. The patient is then placed in the Trendelenburg position, and the bladder exposed suprapubically. The peritoneum is stripped off, the ureter and large vessels are exposed and clamped, and the bladder raised and detached from the prostate. The prostate may be removed with the bladder (cysto-prostatectomy).

In the female (Pawlik's operation) the ureters are exposed from the vagina, cut across and implanted in the vaginal wall, and after some weeks the bladder is exposed and removed by a suprapubic operation. The urethra is implanted into the vagina, the outlet of which is almost closed. The vagina forms a reservoir for the urine.

Results of operation.—In 30 cases in which I resected the bladder wall for malignant growth, there were 3 deaths (10 per cent.). In 10 of these, one ureter was transplanted. Watson collected 96 cases, with a mortality of 21·8 per cent. Kümmel found that of 47 cases, 10 were well sixteen, fifteen, eight, and six and a half years after operation. In 39 cases of cystectomy collected from the literature the operative mortality was 48·1 per cent. Only 10 cases could be traced, and in but 2 of these was the period longer than fifteen months; one was above five years (Hogge) and one sixteen years (Pawlik).

Palliative treatment.—This is adopted when radical operation is contra-indicated.

Hæmaturia.—The patient is confined to bed, and the foot of the bed is raised. Opium, ergot and calcium lactate are given. The bladder is washed with large quantities of hot silver-nitrate solution (1 in 10,000), continuous irrigation being made through a double-way catheter. This is followed by the instillation of a little adrenalin solution (1 : 1,000). If the bladder is distended with clot an attempt should be made to remove the clot by means of an evacuating cannula and bulb, and, this failing, the bladder should be opened suprapubically, the clots cleared out, and a large rubber drainage-tube inserted. Partial operations sometimes relieve severe bleeding.

Pain.—Suppositories of extract of belladonna (½ gr.) to which cocaine (½–1 gr.) may be added, or the injection of tincture of opium (20 min.) with antipyrin (30 gr.) in hot water as an enema may give relief. Washing the bladder with silver nitrate solution may be beneficial, and if the urine is alkaline and phosphatic material is being deposited, sodium acid phosphate (20 gr

Symptoms.—Hæmaturia is the most frequent (90·2 per cent.) and the earliest symptom. A little blood appears at the end of micturition at first intermittent but later becomes constant, and there may be intercurrent severe attacks of hæmorrhage.

Frequent micturition occurs in 68 per cent. of cases, and may be the initial symptom It is nocturnal as well as diurnal, and is usually due to cystitis although it may occur without cystitis and with a clear urine.

Pain is due to cystitis, to obstruction by blood-clot, or to pressure on nerves. It is felt along the urethra, at the end of the penis, in the suprapubic region and groin, in the perineum anus, and down the thighs or along the sciatic nerve The urine sometimes contains a persistent excess of epithelial bladder cells, and portions of the growth may be passed. Flat or limpet-shell-shaped phosphatic concretions may form on ulcerated patches and be discharged with the urine. Emaciation is present in advanced cases.

Diagnosis.—There are two clinical types—(1) cystitic (40 per cent.) (2) hæmaturic (60 per cent.) Cases belonging to the cystitic type may be mistaken for stone, simple enlargement of the prostate, or malignant disease of the prostate. The diagnosis is made by rectal examination and cystoscopy The hæmaturic type must be distinguished from simple papilloma or tuberculous disease by examination of the urine for the tubercle bacillus and by cystoscopy

Course and prognosis.—The average duration of life after the first appearance of symptoms is under three years. Septic cystitis and ascending pyelonephritis is the usual cause of death. Radical operations in the early stages give an increasingly favourable prospect of cure (see below)

Treatment.—Radical operation should be undertaken if the growth is confined to the bladder and the patient sufficiently robust It is contra indicated by renal, pulmonary or circulatory inadequacy The radical operations are (1) resection of the bladder wall, (2) cystectomy

1 **Resection** is preferred wherever possible as the mortality is 10 per cent , compared with 46 per cent. in cystectomy The following conditions are unsuitable for resection, though they do not contra indicate cystectomy viz. (1) very extensive growths confined to the bladder (2) rapidly growing malignant papilloma, (3) growths involving both ureters the trigone or urethra, (4) intractable cystitis.

Free exposure the Trendelenburg position, and good illumination are necessary The area of the bladder wall with the perivesical fat giving a margin of an inch all round the growth is removed. If this includes the ureteric orifice the ureter is implanted into the upper part of the bladder wound.

thrice daily) and urinary antiseptics should be given. Washing with a very weak solution of acetic acid often affords relief. Suprapubic cystotomy may become necessary and is followed by continuous irrigation, a permanent suprapubic drain being established.

Partial operations may relieve pain, but should be avoided when severe cystitis is present.

Nephrostomy after ligature of the ureter (Watson), ureterostomy or implantation of the ureter in the loin on one side with nephrectomy (Harrison) or on both sides (Fenwick) may be used in inoperable carcinoma of the bladder with great pain.

Connective Tissue New Growths

Sarcoma of the bladder is found in infancy and late adult life but is rare. The growth arises in the submucous or in the perivesical areolar tissue or rarely from the intramuscular connective tissue; it is situated on the posterior or lateral walls. The tumour is pedunculated or sessile and infiltrating. The bladder cavity may be filled with polypoid masses, and the wall infiltrated with growth. The urethra is sometimes blocked, and the polypoid masses may appear at the external meatus in the female.

The varieties are spindle-celled, round-celled, melanotic, myxosarcoma, rhabdo-myoma, and chondro-sarcoma.

Other connective-tissue tumours, such as myoma, myo-fibroma, and myxoma, are only rarely found. Dermoid cysts have been described.

VESICAL CALCULUS

Etiology.—The etiology of stone-formation in the urinary tract is discussed under Renal Calculus (p. 873).

Stone in the bladder is less frequent in children than in adults, and much more frequent in men (especially old men) than in women. Calculi are "primary" when they form in an aseptic urine, and "secondary" when they result from bacterial changes in the urine. The nucleus may be formed by a small oxalate-of-lime or uric-acid calculus descended from the kidney, or a portion of blood-clot, a fragment of a catheter, a pin, a silk ligature, a fragment of necrosed bone, or other foreign body in the bladder. The two important predisposing factors in the production of secondary calculi are bacterial action and stagnation of urine. This combination is frequently found in old men with enlarged prostate and cystitis.

Pathology.—Vesical calculi are formed of uric acid, phosphates, or oxalate of lime, in that order of frequency, and rarely of cystin, indigo, or calcium carbonate.

Uric-acid calculi (Fig. 63[illegible]) may consist of pure uric acid or of ammonium or sodium urates. They are single or multiple, rounded, oval, or flat. The surface is smooth or finely nodular and easily polished. They are

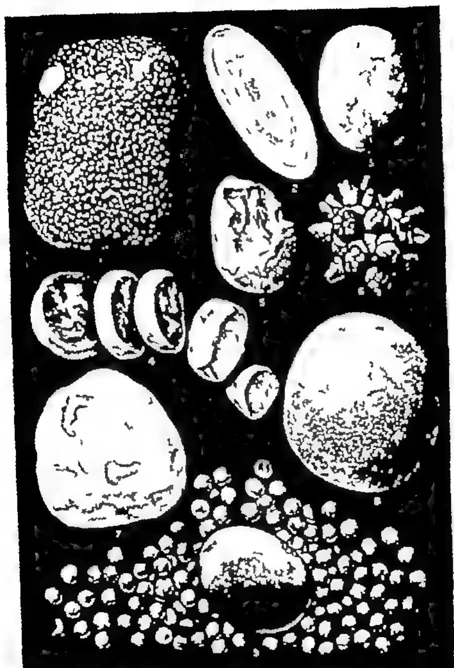


Fig 662.—Collection of vesical calculi.

3, Large uric acid calculi 4, collection of disc-shaped phosphatic calculi 5, calculus formed on silk suture 6, mulberry calculus (oxalate of lime) 7 large phosphatic calculus 8, phosphatic calculus from diverticulum 9, collection of vesical calculi in enlarged prostate

sandy yellow to dark brown, show regular concentric lamination, and are of hard consistence. *Oxalate-of-lime* calculi (Fig. 552, 6) are usually single, vary from a pea to a chestnut in size, and have a dark brown colour. The surface is covered with closely set conical bosses (mulberry calculus) or a few sharp projecting spines (star form). They are very hard, and on section show irregularly disposed laminæ. *Phosphatic* calculi (Fig. 552, 4, 7) consist of basic calcium phosphate, alone or mixed with ammonio-magnesium phosphate, and perhaps with ammonium urate. They are soft and crumbling, but when crystalline are very hard. On section, they are granular and rarely show lamination. *Cystin* calculi are oval, granular, yellowish brown, have a soapy appearance, and turn greenish yellow when exposed to air. *Xanthin* stones are smooth and yellow and *indigo* are blue, while *calcium carbonate* are greyish white, earthy-looking, hard stones. Calculi are rarely composed of a single ingredient.

Phosphatic stones develop rapidly a large stone forming in a few weeks. Uric-acid calculi form less rapidly and oxalate stones require some years to reach moderate size.

Vesical calculi may be movable or may be fixed in diverticula (Fig. 552, 8) or saccules, or in the ureteral or urethral orifices. A stone may be spasmodically grasped in the upper part of the bladder, or may be wedged behind an enlarged prostate.

Multiple stones may be present to the number of 400 or 500.

Cystitis may precede the development of a calculus, or result from its presence. Papilloma or malignant growth rarely complicates stone. Chronic pyelonephritis is the usual cause of death.

Symptoms.—There may be preceding attacks of renal colic when the stone or its nucleus has descended from the kidney. Fixed and very large calculi are latent.

Frequent micturition and discomfort after micturition are the earliest and most common symptoms. The frequency of micturition is absent at night unless severe cystitis is present. Pain is felt in the neck of the bladder and is referred to the end of the penis it is sharp and cutting, and is experienced at the end of micturition. Hæmaturia is frequently present It is slight, and appears at the end of micturition and the blood is bright An intermittent stream is sometimes observed, and complete retention may occur All the symptoms of stone are aggravated by jolting movements and improved by rest

The urine contains crystals of oxalate of lime, uric acid or phosphates microscopic quantities of blood an excess of leucocytes, and usually some epithelial cells. In children, screaming on micturition and retention of urine are not infrequent, or there may be active incontinence of urine. In small boys "milking" of the penis to ease the pain leads to an enlarged turgid, semi-erect condition of the organ which is very characteristic. When cystitis complicates stone the frequency of micturition becomes nocturnal as well as diurnal, the pain is increased, and pus and mucus appear in the urine which frequently becomes alkaline and stinking

In old-standing cases symptoms of ascending pyelonephritis appear and the patient shows signs of urinary septicæmia.

Diagnosis.—The severity of the pain and its sharp character the diurnal frequency and the pronounced effect of movement and jarring on all the symptoms are characteristic of calculus. The previous passage of a stone or past operations for stones are important points. Fixed stones do not produce the characteristic symptoms. Rectal and vaginal examination usually fails to detect the stone. When the calculus is large it may be detected bimanually especially in children.

The bladder is examined with a sound after introducing a few ounces of fluid, and the impact of the metal instrument on the stone gives a characteristic sensation and sound. In children the stone lies at the neck of the bladder in adults behind the trigone and in old men frequently behind an enlarged prostate. The ridges of a trabeculated bladder phosphatic deposit and new growths may give rise to difficulties in diagnosis with the sound and care should be taken that the handle does not come in contact with a ring or button.

A small stone may be detected by using a lithotrity evacuator and bulb.

Cystoscopy is the most certain method of detecting a calculus, and is especially useful in fixed calculi. Radiography shows a shadow in the vesical area.

Treatment.—A small calculus may sometimes be removed by means of the cannula and aspirator used in litholapaxy.

The operations performed for stone in the bladder are of two classes, viz. (1) Crushing (litholapaxy or lithotrity) (2) cutting (lithotomy).

Litholapaxy or lithotrity.—The modern operation of litholapaxy (Bigelow 1878) consists in crushing a stone and removing the fragments at one sitting. Four or five ounces of boric solution are introduced into the bladder, the lithotrite is passed the handles are raised, the blades separated. The stone rolls in between the blades and is caught. The blades are now locked and the male blade screwed home and this manœuvre is repeated until all the fragments are crushed, when the lithotrite is removed. A large cannula is now passed, and the aspirator bulb applied. By alternate compression and relaxation the fragments are swept into the bulb and fall by their weight into the glass bulb. When all the fragments have been removed the bladder is washed with weak nitrate-of-silver solution and a catheter tied in the urethra for a few days.

Litholapaxy has been performed upon young children. The youngest child on whom it has been done, a boy of 15 months, was under the author's care.

Difficulties and contra-indications.—Litholapaxy is contra-indicated by (1) severe and persistent cystitis, (2) considerable enlargement

of the prostate (3) advanced sacculation, (4) fixed calculi, (5) spasmodic contraction of the bladder (6) new growths of the bladder complicating stone, (7) very large and hard stones.

Urethral stricture or a narrow meatus should be treated before litholapaxy is performed.

Perineal litholapaxy through a median external urethrotomy wound has been performed, but it is inferior to litholapaxy and to suprapubic lithotomy

Dangers —Ascending pyelonephritis and perforation of the bladder wall are rare A rise of temperature may occur when cystitis is present and is avoided by careful preparation of the bladder and by tying in a catheter and washing the bladder after the operation.

Suprapubic lithotomy —The bladder is distended with fluid and opened suprapubically and the stone removed by lithotomy forceps or a scoop. If the prostate is enlarged prostatectomy is now performed

Median perineal lithotomy.—The patient is placed in the lithotomy position and the membranous urethra opened on a staff by a median perineal incision.

The forefinger is introduced along a gorget into the bladder and a pair of lithotomy forceps or a scoop passed alongside this and the stone removed A rubber perineal drainage tube is tied in the bladder for some days.

Lateral lithotomy is now abandoned in favour of one of the methods here described

Vaginal lithotomy consists in opening the bladder base behind the trigone on an instrument introduced through the urethra, and removing the stone with lithotomy forceps. Vesico-vaginal fistula is a frequent sequel

Results of operation —The results in 1 670 cases of stone in the bladder operated on at St. Peter's Hospital in the years 1864–1910 showed a mortality in the first decade of 15·25 per cent., and of 3 30 per cent. in the last decade.

The death-rate of litholapaxy varies from 2 per cent. (Legueu) to 3·6 per cent. (Zuckerkandl).

In the practice of surgeons who perf ... hotrity supra ubic or perineal lithotomy shows a high death rate, ... vest c ... ted in this way Thr... yer's statistics sh... litho ... y of 18·2 and ... lithotomy mort... per ... however ... re treated in ... are less ... In ... y found

guide of a urethrotome are examples. Foreign bodies are frequently introduced by the patient. The mucous membrane becomes inflamed at the points of contact with the foreign body, and ulceration and even penetration of the bladder wall may follow. The foreign body becomes encrusted with phosphatic deposit, and a large phosphatic stone is formed. The symptoms are similar to those of stone in the bladder, and the diagnosis is made from the history, by radiographic examination, and by cystoscopy.

Treatment.—Urethral operations are most suitable in the female subject, but are also feasible in some cases in the male. In the female a large Kelly's tube is used after dilatation of the urethral orifice, and the patient placed in the Trendelenburg position. The foreign body is seized with fine forceps and removed, a finger in the vagina assisting the manœuvre. In the male Luys' direct cystoscope should be used. A filiform guide or a drainage-tube may be removed through the urethra by means of a lithotrite. When these methods fail (60 per cent.) the bladder is opened suprapubically, the foreign body removed, and, unless severe cystitis with ulceration is present, the wound is closed.

PERICYSTITIS AND PERIVESICAL ABSCESS

Etiology.—Pericystitis may be secondary to disease or injury of the bladder, or it may arise in the neighbouring organs or structures, such as the urethra, rectum, prostate, appendix, or pelvic bones. Men are more frequently affected than women. Two forms are recognized: (1) Chronic fibro-lipomatous pericystitis with or without points of suppuration; the bladder is surrounded, especially at its base and around the seminal vesicles and lower ends of the ureters, by a thick fibro-lipomatous mass. (2) Perivesical suppuration and abscess; in the diffuse form the areolar tissue is widely infiltrated, in the circumscribed form the pus is thick and foul. The abscess may rupture into the bladder, rectum, peritoneum, or bowel, and a recto- or entero-vesical fistula follow.

Symptoms. 1. *Pericystitis from bladder disease.*—There is a greatly thickened bladder wall, and perhaps an abdominal tumour. When a diverticulum is present it may be demonstrated by radiography after distension of the bladder with bismuth emulsion.

Localized perivesical suppuration may develop slowly and escape recognition. An acute abscess may rupture into the bladder, causing an acute cystitis. The temperature is high, the patient is seriously ill and may have repeated rigors. A tumour is found on suprapubic or bimanual palpation, which may be mistaken for malignant growth, or a boggy mass can be felt from the rectum. The abscess may rupture into the rectum or bowel, and a recto- or entero-vesical fistula forms with discharge of fæces and gas by the urethra.

Prevesical abscess, or abscess of the space of Retzius, may be acute or chronic. In acute prevesical abscess, in addition to the symptoms of abscess, there are suprapubic pain and tenderness, dullness on percussion, and above the pubes appears a prominent rounded swelling, which closely resembles a distended bladder, but remains unchanged on emptying the bladder. In chronic prevesical abscess there are obscure pain and a moderate degree of cystitis.

2. *Pericystitis from disease of other organs.*—When an appendicular abscess invades the pelvis it may open into the bladder. There are signs of cystitis, and later the discharge of a quantity of fetid pus in the urine, followed by acute cystitis, and a fistula may form between the cæcum or appendix and

Atony of the bladder without obstruction or signs of nervous disease.—I have described a series of cases under this title. The condition occurs in young and middle-aged patients, and is unconnected with venereal disease. There is gradual onset of difficulty in micturition, delay feeble and intermittent stream. Chronic distension of the bladder with voluntary micturition may be present, or residual urine amounting to 4 to 10 oz. There is loss of sensibility of the bladder in some cases and increased sensibility in others. Well marked trabeculation (atrophy) of the bladder is present in all.

Urethral *obstruction* and *spinal* disease are *eliminated*.

The disease was present in cases for eight to eighteen years without the development of nervous lesions. The lesion is probably localized in the hypogastric and hæmorrhoidal plexuses of the sympathetic.

Injury to the nervous system.—Comer gives the following table of the state of the bladder in various injuries —

Concussion of the brain.

1 Reflex or unconscious micturition.
2. Active retention: (*a*) active overflow; (*b*) passive overflow (*c*) absolute retention.

Compression.

1 Passive retention.
2. Active paralytic overflow
3. Passive paralytic overflow

Spinal injuries.

1. Supralumbar lesions: (*a*) active retention; (*b*) reflex micturition; (*c*) exaggerated reflex micturition.
2. Lumbar lesions: (*a*) passive retention (*b*) active paralytic over flow; (*c*) passive overflow

The author showed, in a large series of cases of spinal injury from gunshot wounds, that where the cord was injured above the lumbar centre there were two stages—(1) a stage of complete retention with overflow the average duration of which was fifty days (2) a stage of involuntary reflex micturition the bladder emptying itself at regular intervals and the frequency depending upon the presence and severity of cystitis. This stage was permanent where the destruction of the cord was complete, but in partial injury and in concussion partial or complete recovery of voluntary micturition might take place.

The chief danger in these cases was ascending pyelonephritis due to septic catheterization, and during the War the mortality from this cause was over 80 per cent. in the first month after the injury The ascent of the infection was due to the distension of the bladder between the catheterizations.

Treatment. 1 Relief of retention and removal of residual urine.—(1) *Intermittent catheterization* —Rigid asepsis must be employed. For complete retention the catheter must be passed thrice in twenty-four hours. When the residual urine does not exceed 8 or 10 oz. the catheter should be passed once a day

In spinal disease the tone of the bladder may improve with regular catheterization. In injuries to the spinal cord the catheter is used during the first stage of complete retention. When involuntary reflex micturition is fully established the bladder empties itself completely and the catheter is not required. Where the surroundings permit of careful aseptic catheterization being carried out this method is satisfactory but under war condi-

tions intermittent catheterization was the cause of death from ascending pyelonephritis in over 80 per cent. of cases in the first month and eventually of at least 80 per cent. of the cases surviving that time

(*) *Permanent catheter drainage.*—A gum-elastic or rubber catheter is tied in the urethra or a self-retaining catheter introduced. The catheter is changed every few days and the urethra washed. Although in some cases the urethra is tolerant urethritis is usually set up, and frequently a peri-urethral abscess develops, and a fistula forms, or the floor of the urethra at the peno-scrotal juncture sloughs, leaving a large opening into the urethra.

(3) *Suprapubic cystotomy.*—The author suggested during the War that no catheter should be passed at any time but that all cases of injury to the spinal cord should be treated by suprapubic cystotomy to prevent the ascending pyelonephritis caused by the recurrent distension of the bladder with infected urine. The suprapubic wound is allowed to heal when reflex micturition is established. In the few cases where this was faithfully carried out, no ascending pyelonephritis occurred.

(4) *Massage of the bladder.*—In some cases of spinal injury it has been found possible to empty the bladder by gentle and regular massage without the passage of the catheter. Unfortunately this is only successful in a few cases, and rupture of the bladder has been known to occur.

2. **Prevention and treatment of cystitis.**—Urinary antiseptics should be given from the commencement of the bladder symptoms, and constipation prevented. If infection has occurred the bladder is washed out (see under Cystitis, p. 903). The bladder should be examined from time to time to ascertain if a phosphatic calculus has formed.

3. **Treatment of atony.**—The patient should be encouraged to try to expel all the urine, he should be regularly catheterized, and should be given ergot (liquid extract, 20–30 minims thrice daily) and strychnine (liquor 5 minims). Mercury and iodides have no effect. The electrical current may be used with advantage, one terminal being placed over the suprapubic region or the sacrum and the other over the perineum, or an electrode may be introduced into the bladder or into the rectum. A weak interrupted current should be used, and at first the sittings are short. The galvanic current may also be employed.

THE URETHRA

Anatomy (Figs. 198, 199 Vol. I., pp. 840, 841).—The male urethra is divided anatomically into three parts—the prostatic (1¼ in.), the membranous (¾ in.), and the spongy urethra (about 6 in.); a *pars intramuralis* is also described.

Clinically the canal is more conveniently divided by the compressor urethrae muscle into the posterior urethra (corresponding to the prostatic urethra) and the anterior urethra, which, again, is divided into the bulbous or perineal and the penile urethra.

The urethra has an S-shaped curve. The internal meatus is situated on a level with the middle of the pubic symphysis and about 2 cm. behind it. Thence the canal passes vertically downwards for about ½ to ¾ in. to the level of the verumontanum there it turns slightly forwards and maintains a forward and downward direction to the junction of the membranous and bulbous urethra. The canal now turns sharply upwards and forwards along the under surface of the triangular ligament. At the peno-scrotal junction it turns downwards in the flaccid penis to the meatus. The fixed curve

If the infection is due to the Bacillus coli, large doses of alkalis should be given. A catheter is tied in the urethra, and in some cases suprapubic drainage is installed. Vaccine and serum treatment may be tried.

The treatment of suppression of urine is discussed elsewhere (p. 821).

CONGENITAL MALFORMATIONS

Congenital Absence or Obliteration of the Urethra

This is rare. The penis is absent or rudimentary and other malformations are present. The bladder may communicate with the rectum, uterus, or umbilicus. The children are usually still-born or die soon after birth.

Partial Obliteration of the Urethra

This may be found in the glans, in the bulbous, membranous, or prostatic urethra. The anterior urethra is most commonly and the prostatic urethra least often affected.

If no outlet is present, there is distension of the bladder with dilatation of the ureters and kidneys. The kidneys may be the seat of congenital malformation and be inactive, so that distension of the urinary passages does not take place. The urine may find an outlet through a patent urachus, a vesico-rectal fistula, a vesico-utero-rectal fistula, a penile or vaginal fistula. In the majority of cases the child is still born or dies soon after birth. If life is prolonged, fatal ascending infection occurs after a few years.

Treatment.—Suprapubic puncture and cystotomy are emergency operations to relieve distension. In atresia of the glans urethræ the dilated urethra should be opened and a penile fistula established, a plastic operation being carried out later on the urethra.

Double Urethra

This is rare, and may be combined with double penis, double scrotum, double bladder atresia ani, and other congenital malformations.

The second urethra may open on the perineum or in the inguinal region. A more frequent condition is where a canal opens on the glans or below the penis and runs backwards on the upper or under surface of the penis. The track varies in length from ½ to 5½ in., and usually ends blindly. In a few cases the canal joins the urethra, and rarely it passes back into the bladder. A double urethra has been described in the female subject.

When the second canal communicates with the urethra or bladder, urine escapes from both orifices. The penis may swing from side to side during micturition. In gonorrhœal infection there is discharge from both orifices, but the infection may attack the abnormal canal while the urethra escapes. When the abnormal canal is the seat of chronic inflammation it may be laid open in its entire length and the lining membrane destroyed with the cautery. A thick scar may result which interferes with erection. Extirpation of the unopened tract by dissection is more difficult, but the after-result is better.

Congenital Narrowing of the Urethra

The points most frequently affected are the external meatus, the junction of the fossa navicularis and the penile urethra, the membranous urethra, and the prostatic urethra. The external meatus is most frequently the seat of stenosis. The symptoms are those of stricture.

Treatment.—In stenosis of the meatus the urethra is slit downwards, and the mucous membrane and skin are brought together by catgut

sutures. In deeply situated stenosis, dilatation with graduated bougies should be tried, and, that failing, external urethrotomy followed by the regular instrumentation.

Congenital Dilatation of the Urethra

This is independent of stenosis. The dilatation affects the under surface of the penile urethra, rarely the bulbous urethra. A similar condition may occur in the female urethra. Symptoms may appear soon after birth, or may be delayed. Micturition is frequent and painful, the stream is poor and is followed by dribbling. A swelling appears on the under surface of the penis during micturition, and the penis may be twisted to one or other side, or becomes erect. Incontinence is a late result.

Treatment.—The sac should be excised, the urethra repaired, and the skin stitched separately. A catheter is tied in after the operation.

Hypospadias and Epispadias

These conditions are considered at pp. 1013, 1014.

PROLAPSE

About 170 cases of this rare condition are on record, more than half of them in girls under 15, and most of the rest in elderly women. (*See* Vol. III p. 2.)

URETHROCELE

This condition—a pouching of the urethral mucous membrane, filled with decomposing purulent urine—is considered at p. 2, Vol. III. A similar condition may occur in men.

INJURIES AND RUPTURE

Injuries

The urethra may be injured from within the lumen by the passage of instruments (*see* p. 928) or from without by cutting weapons, bullets, etc. The penile urethra is most frequently affected but the bulbous urethra and the prostatic urethra may be extensively torn by bullets or other missiles. Where the perineum is the exit of a bullet wound traversing the pelvis, widespread destruction of the bulbous, membranous, and prostatic urethra the rectum, and the perineal muscles may result, and there is frequently in addition, fracture of the pelvic bones with detachment of fragments. Hæmorrhage is usually severe. When free exit for the urine is afforded, no extravasation takes place but when the urethral wound does not correspond to the skin wound widespread extravasation is likely to occur. When the wound is small immediate exploration and suture of the urethra should be carried out, and a catheter tied in the urethra for four days. In larger wounds hæmorrhage is first controlled and then bruised and semi-detached portions of tissue fragments of bone, and foreign bodies are removed. The wound is left freely open. Retention of urine is relieved by suprapubic cystotomy. At a later date plastic operations should be undertaken.

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RUPTURE

There may be bruising of the mucous membrane (interstitial rupture) rupture of the fibrous sheath (partial external rupture) of the mucous membrane (partial internal rupture) or of the mucous membrane, corpus spongiosum, and fibrous sheath (total rupture). A part of the circumference of the urethra (partial rupture) or the whole circumference (complete rupture) may be affected. In complete rupture the severed ends retract and may be widely separated.

Rupture of the *penile* urethra is rare, and results from injuries during erection. The seat of election is the peno-scrotal junction.

Rupture of the *bulbous* urethra is more frequent and results from a kick, or blow or fall on the perineum. The rupture is usually complete and total, and the severed ends retract some distance. The position of the rupture depends upon the attitude of the body at the time of the injury A force striking the perineum from before backwards injures the bulbous urethra, but one striking the perineum from behind forwards damages the membranous urethra. The urethra is crushed between the injuring body and the pubic arch and triangular ligament. Rupture of the *membranous* urethra occurs in severe injuries with fracture of the pelvis or dislocation of the pubic bones. The *prostatic* urethra is rarely ruptured.

Symptoms.—In *penile* rupture there is hæmorrhage from the meatus for a few days, pain on micturition, but rarely retention of urine Extravasation of urine does not occur but stricture invariably follows Rupture of the *bulbous* urethra is the most common form. After a blow on the perineum there is sharp pain, increasing in severity and blood appears at the meatus. A tumour rapidly forms in the perineum, which becomes tense and tender In slight cases where the fibrous sheath is not ruptured this swelling is absent. Retention of urine frequently follows the injury *Membranous* or *prostatic* rupture is associated with fracture of the pelvis, and may escape observation at first Hæmorrhage is slight and bruising appears in the perineum after some days. There is retention of urine A tender swelling is felt on rectal examination and the abdominal muscles are frequently rigid. The bladder is distended.

Diagnosis.—The history and symptoms are usually sufficient to make the diagnosis easy Differentiation between rupture of the posterior urethra and extraperitoneal rupture of the bladder is difficult. In the former tenderness and swelling are present around the membranous and prostatic urethra on rectal examination and on passing a catheter there is obstruction at the posterior urethra. The bladder is distended in rupture of the urethra. In intraperitoneal rupture of the bladder there is no hæmorrhage from the urethra, no

swelling or tenderness of the urethra, no distension of the bladder and a catheter passes without obstruction.

Prognosis.—In *penile* rupture the symptoms rapidly subside but a stricture forms within a few months. In *bulbous* rupture extravasation and infection follow the attempted passage of urine and the patient may succumb if operation is delayed. In less severe cases the hæmatoma breaks down and fistulæ form in the perineum. Stricture usually follows in a few weeks but may be delayed for some years.

Treatment.—In rupture of the *penile* urethra the canal is washed with silver-nitrate solution (1 : 10,000) and a soft catheter is tied in for four days. Metal instruments are passed after a fortnight and this is continued regularly. In *bulbous* rupture a gum-elastic catheter with stilet is passed gently along the urethra, keeping to the roof. If it enters the bladder the urine is drawn off and the instrument kept in position. If it does not pass the rupture it is left in the urethra. The patient is placed in the lithotomy position and the hæmatoma incised. A curved transverse incision is preferable for membranous rupture and a median incision for bulbous. The clots are turned out and the oozing is stopped by irrigation with hot lotion. If the urethra is only partly severed the torn edges are readily found and are trimmed and sutured with catgut over a catheter which is tied in position. If the urethra is completely severed the vesical end is difficult to find. The two ends are united with catgut and the perineum repaired. If the ends cannot be approximated the cavity is lightly packed and drained and a catheter fixed in place. Suprapubic drainage should be established and continued for a fortnight. Should the vesical end not be found, suprapubic cystotomy must be performed and the end identified after retrograde catheterization.

Results.—The mortality of uncomplicated rupture of the urethra was 14.15 per cent. in 205 cases (Kaufmann). Treatment by retained catheter has a mortality of [redacted] 17 per cent., and rupture of the urethra with fracture of the pelvis a mortality of 40 per cent.

In a large number of cases, immediate operation has prevented the formation of stricture or reduced the contraction to a linear scar readily amenable to treatment.

CALCULUS

There are two varieties of this condition—(1) primary, when the stone originates in the urethra; (2) secondary, when a migrating calculus is arrested in the canal.

Etiology.—Primary calculi originate in phosphatic crusts that are deposited on raw surfaces in the urethra, especially when stricture is present, or in a para-urethral pocket.

Pathology.—Primary urethral calculi are composed of calcium and magnesium phosphate, ammonio-magnesium phosphate, or calcium carbonate.

Secondary calculi have a nucleus of uric acid, calcium oxalate, or other ingredients found in renal or vesical calculi. As the calculus grows it is moulded by the shape of the urethra, and the urethra itself becomes dilated. Several faceted calculi may be found. When a urethral calculus projects into the bladder it takes a mushroom or umbrella shape. In the majority of cases one or several strictures coexist, and the calculus lies behind a stricture or between two strictures. Perineal fistulæ may be present. A calculus may lie in a pouch communicating with the urethra, and project into the canal.

Symptoms. 1 **Impaction of a migrating stone.**—There is frequently a preliminary attack of renal colic, when the stone descends from the kidney The stone is felt to enter the urethra during micturition, and there is sudden arrest of the stream, intense pain, and continuous ineffectual straining, with the passage of a few drops of blood followed by complete retention of urine. On passing a metal catheter the membranous urethra is found spasmodically contracted, and the click of a stone is felt in the prostatic urethra The calculus may be felt from the rectum. Recurrent attacks of difficult micturition or complete retention occur when the stone becomes impacted behind a stricture of the bulbous or penile urethra, and the calculus can be felt on palpating the urethra.

2 **Stone lodged in the urethra.**—There are pyuria and a urethral discharge difficult and frequent micturition discomfort and a feeble twisted stream. Urinary fistulæ may be present and there is usually a stricture. The stone is felt on palpation and seen on urethroscopic examination.

Treatment.—A migrating calculus of the prostatic urethra is usually pushed back into the bladder on passing a catheter It should be evacuated with a lithotrity bulb or crushed and removed If the calculus is not pushed back into the bladder the catheter may be tied in position for a few days on its being removed the stone will probably be expelled.

Small calculi in the penile and bulbous urethra can sometimes be removed with urethral forceps or a snare if no stricture is present. If they lie behind a stricture external urethrotomy is necessary A fixed calculus in the prostatic urethra should be removed by median perineal section, and the bladder explored for other stones. When calculi are embedded in para urethral pockets the wall of the pocket should be carefully destroyed.

FOREIGN BODIES

A large variety of foreign bodies may be found in the urethra of erotic individuals, and portions of surgical instruments may be accidentally left in the canal The foreign body does not remain for long in the urethra. It is either forced out by the urine or removed by the surgeon, or it may pass backwards into the bladder When it remains in the urethra there are purulent discharge, pain, burning, and hæmorrhage increased by erections. Frequent micturition, difficulty dribbling, and sometimes complete retention

of urine occur The foreign body quickly becomes encrusted with phosphates. Periurethritis and periurethral abscess may result. The situation is usually the fossa navicularis or the bulbous urethra, rarely the prostatic urethra.

Treatment.—The body may be swept out by the stream of urine if the meatus is compressed during the flow and then suddenly relaxed. A long, firm body may be pressed out from the perineum or penis. Meatotomy is frequently necessary.

A pin with a round head lies in the urethra with the head bladderwards and the point buried in the mucous membrane. The point should be manipulated through the urethra and skin, and the pin drawn out, the head reversed, and then pushed out of the meatus. Small bodies or portions of catheter may be withdrawn by means of long, fine urethral forceps and a magnet has been employed to remove an iron foreign body.

The urethroscope is used to diagnose and remove foreign bodies, urethral forceps being passed along a large urethral tube.

If these measures fail, external urethrotomy should be performed and the foreign body removed. When the foreign body lies in the prostatic urethra it will be easier to push it back into the bladder and deal with it as a foreign body of the bladder.

STRICTURE

Stricture of the urethra is congenital inflammatory or traumatic. The congenital variety has already been described (p. 930).

Etiology.—The female urethra is very rarely affected. Acquired stricture has been observed in male infants, but the age is usually between 20 and 40 years.

Inflammatory stricture results from chronic urethritis, which has a gonorrhœal origin in 90 per cent of cases. Any condition which tends to prolong the inflammation in chronic urethritis, such as a narrow meatus, phimosis, injudicious treatment, alcohol, or exposure acts as a predisposing cause. Rarely chronic urethritis due to tuberculosis of the urethra or diabetes produces stricture. Stricture has followed a urethral chancre or a gumma.

Pathological anatomy.—In traumatic stricture fibrous tissue develops between the severed ends of the ruptured urethra, the extent of which depends upon the distance they lie apart, necrosis from the injury or subsequent sloughing from septic complications. The lesion develops rapidly, is single and the seat of election is the bulbous urethra. A thick tough mass of fibrous tissue involves the mucous and submucous coats and the cavernous tissue and sometimes also the perineal tissues and skin.

Gonorrhœal strictures are usually multiple and most frequently affect the bulbous urethra. The prostatic urethra is very rarely affected in gonorrhœal stricture. The strictured portion of the wall is confined to a narrow circular band but it may measure an inch or more in old-standing cases or rarely almost the whole length of the anterior urethra is sclerosed. Complete obliteration of the lumen has been recorded but is very rare.

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The following terms have been applied, viz. "annular" stricture a fine band involving the whole circumference (Fig. 553) bridle stricture an isolated band stretching across the lumen "resilient" stricture, an elastic stricture which recontracts quickly after dilatation "cartilaginous stricture, a hard fibrous mass, usually of considerable extent. In an "irritable stricture there is a rise of temperature or even a rigor after each instrumentation. An "impassable stricture is one through which no instrument can be passed. A stricture may affect the whole circumference of the urethra or only the floor roof, or lateral walls. The lumen is central or eccentric and it may be tortuous.

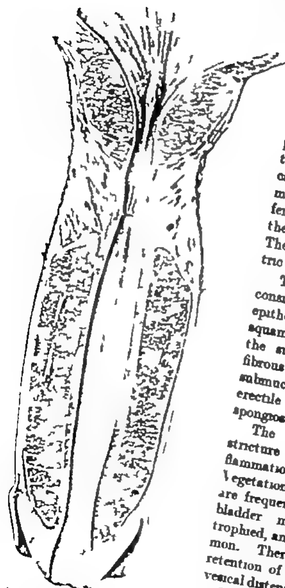


Fig 553 —Annular stricture of the bulbous urethra.

The histological changes consist in proliferation of the epithelium, which becomes squamous, and sclerosis of the subepithelial tissue the fibrous tissue invading the submucous tissue and the erectile tissue of the corpus spongiosum.

The urethra behind the stricture shows chronic inflammation and dilatation. Vegetations and ulcerations are frequently present The bladder muscle is hypertrophied, and cystitis is common. There may be acute retention of urine or chronic vesical distension. The ureters and eventually the kidneys become dilated, and ascending septic pyelonephritis is usually present in old-standing cases.

Symptoms.—In stricture of large calibre the only symptom may be a persistent purulent discharge (gleet). In stricture with small lumen the stream is small, thin, twisted, forked or sprayed, or it may appear in small jets or only in drops. The projection is feeble; there may be a pause before micturition commences, and the stream finishes in a dribble. Frequent micturition is usually due to chronic urethritis of the prostatic urethra or to cystitis. Pain may be felt at the seat of the stricture during micturition, at the external abdominal rings or in the back over the kidney on one or both sides. Pain on ejaculation and backward flow of semen into the bladder occur and are a cause of sterility.

Retention of urine may be transient, lasting a few minutes or half an hour. Acute total retention of urine is caused by a chill, dietetic or alcoholic indiscretion or sexual excess. There is severe suprapubic cramping paroxysmal pain; the patient is pale and sweating and the bladder is felt as an oval suprapubic swelling. No urine escapes or only a few drops from time to time. In some cases there is a remarkable absence of pain. Retention of urine is due to spasm of the compressor urethræ muscle or congestion of the mucous membrane at the stricture. Incontinence of urine is observed in narrow strictures. A small quantity of urine may be retained in the urethra behind the stricture and dribble away after micturition. Involuntary dribbling of urine is observed when the bladder is chronically over distended.

In the later stages chronic cystitis is present and there is frequent and painful micturition day and night. In longstanding stricture dilatation and septic infection of the ureters and kidneys lead to symptoms of urinary septicæmia and of renal failure.

Examination.—A cartilaginous stricture can be felt on palpation, and becomes more distinct when a bougie is passed.

To detect a stricture a large gum-elastic bougie (No. 20 F. or 21 F.) should be introduced along the urethra; it is arrested by the stricture. Spasm of the compressor rarely causes obstruction sufficient to resist gentle pressure with a bougie of this size. Smaller instruments are now passed until one is found which will enter the lumen of the stricture. In strictures of comparatively large calibre an acorn tipped bougie is used. The acorn tip passes through the stricture and on being withdrawn the shoulder of the acorn hitches at the stricture and the length of the stricture can be ascertained. The aero-urethroscope is useful in diagnosing strictures of wide calibre.

Diagnosis.—1. Spasm of the compressor urethræ (spasmodic stricture) is caused by acute or chronic inflammation of the prostatic urethra. The difficult micturition is here intermittent in character; the obstruction lies in the position of the membranous urethra

gentle continuous pressure succeeds in overcoming this resistance and the aero-urethroscope shows the contracted membranous urethra.

2 Malignant disease of the prostate gives rise to increasing difficulty of micturition. The onset of symptoms in stricture dates from a much earlier age, and the position of the obstruction and rectal examination are sufficient to make a diagnosis.

Complications.—The following are complications that may be observed —

1 Retention of urine.
2 Septic complications (acute or chronic urethritis, periurethral abscess, acute or chronic prostatitis, epididymitis, cystitis, pyelonephritis, pyonephrosis)
3. Extravasation of urine.
4. Fistula.
5 Stone in the urethra.
6 Malignant growth of the urethra.

Treatment by dilatation.—Metal instruments or flexible bougies of silk or cotton web are used. The surgeon stands on the left of the patient and handles the instrument with his right hand while he manipulates the penis with the left.

In introducing a metal instrument the tip is inserted into the meatus while the shaft lies transversely across the left Scarpa s triangle. The handle is carried towards the patient s abdomen and onwards to the middle line and gradually raised. The left hand leaves the penis and is used to support the perineum. The handle is now raised to the vertical and swings down between the thighs being transferred to the left hand. In passing elastic bougies the penis is grasped behind the glans and the organ kept on the stretch The bougie is introduced and lightly held by the forefinger and thumb of the right hand. If the bougie is arrested it is withdrawn a little and again pushed gently on. If this fails progressively smaller instruments should be used until the size that will pass is reached. A filiform bougie should only be used after larger instruments have failed If it does not pass, the end may be bent to an angle and the face of the stricture searched around its periphery Assistance may be obtained by introducing a syringeful of oil into the urethra and gripping the meatus to retain the oil. If this is unsuccessful a number of filiform bougies may be passed together down to the stricture and each tried in succession An instrument sometimes passes readily when the patient is placed under an anaesthetic or under spinal analgesia, when all other methods have failed If these attempts fail and no retention is present the patient is replaced in bed and a brisk purge administered. A further trial will usually be successful.

Most strictures are amenable to instrumental dilatation. Dilata

tion is carried out in three ways—(a) as intermittent dilatation (b) as continuous dilatation (c) as rapid dilatation *Intermittent* dilatation is the method of treatment of the majority of strictures A bougie which fits the stricture is found and progressively larger instruments, rising one size at each interview are passed at intervals of at first four or five days, and then a week and when the size reaches 18 or 20 F a fortnight s and then three weeks interval is allowed. As the larger sizes are reached the intervals are extended to two three four months and finally six months and a year Above the size of 22 F., steel instruments should be employed

The urethra should be washed before and after the passage of an instrument and urinary antiseptics administered. Strictures which have not become tough and leathery from long duration irregular treatment, or chronic inflammation will be completely relieved by this method

Continuous dilatation is useful in cases where retention of urine has complicated a very narrow stricture The patient is confined to bed, a filiform bougie passed and fastened in and the urine trickles alongside. At intervals of twelve hours a progressively larger instrument is substituted until the stricture permits the entrance of a medium-sized bougie. Intermittent dilatation is then substituted.

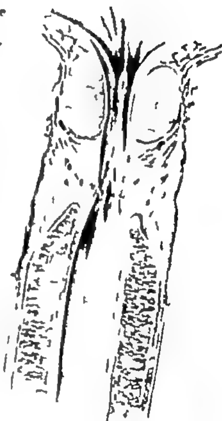


Fig 554.—Stricture of the bulbous urethra with recent false passage

Rapid dilatation consists in passing bougies of increasing size in quick succession through the stricture until a large size is reached. This method may rupture the stricture although the epithelial covering may remain intact and lead to the development of a denser stricture at a later date It is sometimes necessary to use this method where it is imperative to tie a catheter in the urethra without delay

Complications of dilatation 1 *False passage* (Fig 554).—

Blood appears at the meatus, and a peculiar sensation of grating is felt. The urethra should be washed with warm boric lotion to which tincture of hamamelis is added. Further instrumentation should be postponed for a week.

2. *Infection*.—This is prevented by the sterilisation of instruments, the lubricant, the hands, the washing of the penis and urethra and the administration of urinary antiseptics before the passage of instruments. Urethral lavage with permanganate-of zinc solution (1 : 5,000) quickly cures the urethritis.

Cystitis and Ascending Pyelonephritis are considered under those headings (pp. 903, 841).

3. *Syncope*.—Faintness or actual syncope may occur. The patient should be recumbent when instruments are passed.

The usual remedies for syncope are adopted. On succeeding instrumentations a solution of novocain (5 per cent.) should be injected into the urethra before the instrument is passed.

Operative treatment.—In a certain number of cases a cutting operation becomes necessary. The following are the indications for operation :—

A. Gradual dilatation may have failed.

1. Cartilaginous stricture.
2. Resilient stricture.
3. Irritable stricture.
4. Hæmorrhage.
5. Recurrent epididymitis.
6. Recurrent retention of urine after instrumentation.
7. Periurethral abscess and extravasation during the course of dilatation.

B. Cases unsuitable for dilatation.

1. Impassable stricture.
2. Urethral complications such as stone, periurethral abscess, extravasation of urine, fistula.
3. The stricture complicates enlargement of the prostate, stone, tuberculosis, chronic cystitis, and new growths of the bladder.
4. Renal complications.

C. The patient is unable or unwilling to carry out dilatation.

1. Residence beyond reach of regular medical aid.
2. Want of time.

Internal urethrotomy.—This consists in cutting the stricture by means of a specially guarded knife (urethrotome) introduced along the urethra. A filiform guide is passed through the stricture, the fine grooved staff is screwed on to it and follows it. A triangular knife is run along the groove and cuts the stricture. A catheter is tied in

the urethra for forty-eight hours Large metal instruments are passed at increasing intervals after the operation

Results.—Of 1 018 patients treated for stricture by internal urethrotomy at St. Peter's Hospital, 8 died (0.78 per cent.). The causes of death were: (1) exacerbation of old-standing pyelonephritis (.0 per cent.); (2) anuria and uræmia; (3) septicæmia; (4) hæmorrhage

Internal urethrotomy usually affords complete relief if followed by the passage of instruments at long intervals. If after-dilatation is neglected, recontraction of the stricture is common.

External urethrotomy with a guide (Syme's operation).—The stricture is dilated to a No 4 English gauge and a Syme's staff introduced. The patient is placed in the lithotomy position and an incision made on the staff just above its shoulder and carried back through the stricture to the membranous urethra. A gorget is introduced and guides a perineal drainage-tube into the bladder

External urethrotomy without a guide —The following operations are undertaken when the surgeon has failed to pass an instrument through the stricture —

(*a*) *Wheelhouse's operation* —A Wheelhouse staff is passed down to the stricture and an incision made upon it about 1 in from the end The staff is hooked in the upper end of the wound the mucous membrane picked up on each side and careful search made for the opening When this is found a probe is passed through the stricture which is then slit up and the operation finished as in Syme's method.

(*b*) If Wheelhouse's operation fails, the incision is carried back and exposes the dilated urethra behind the stricture a probe is passed through the stricture from behind forwards and the scar tissue slit on this.

(*c*) *Cock's operation* was originally introduced for cases of acute retention in impassable stricture The tip of the left forefinger is placed in the rectum on the apex of the prostate and a knife entered in the middle line of the perineum ½ in in front of the anus and pushed straight for this point The dilated urethra behind the stricture is opened.

(*d*) *Suprapubic cystotomy* and retrograde catheterization followed by perineal section has little to recommend it over the perineal dissection (*b*)

Results of external urethrotomy.—The mortality was 8 per cent. in 100 cases at St. Peter's Hospital. Gregory found a mortality of 5·8 per cent. in 992 cases. Bougies should be passed at regular intervals after the operation.

Excision of strictures —A single stricture of moderate dimensions may be resected. The urethra is slit longitudinally for 2 in and the strictured portion dissected out. The ends of the urethra

are united, but the longitudinal incision may be allowed to close without suture (Russell Hamilton) About 1½ in of the urethra may be removed, and the spongy body is mobilized to allow of the approximation of the ends. The urine is drained for a fortnight through a suprapubic opening Satisfactory results have been obtained, but the operation is limited in applicability

PERIURETHRITIS AND PERIURETHRAL SUPPURATION

The source of infection is the urethra and the inflammation takes various forms, such as abscess, masses of fibrous tissue, gangrenous or phlegmonous inflammation ("extravasation of urine").

Etiology.—The urethra is usually the seat of stricture but injury during instrumentation or internal urethrotomy new growths of the urethra foreign bodies calculi, or a retained metal catheter may be the predisposing cause. There is usually a mixed infection of B coli, streptococcus, and staphylococcus rarely one of these is present in pure culture. Anaerobic bacteria are usually found mixed with aerobic bacteria, but occasionally alone. They are especially frequent in phlegmonous periurethritis ("extravasation of urine") Inflammation spreads either by thrombosis in the corpus spongiosum or by extension of inflammation along the urethral gland ducts.

Periurethral Abscess (Urinary Abscess)

The abscess may develop in relation to the penile or bulbous urethra during the course of acute gonorrhœa or chronic urethritis A tender swelling appears on the under surface of the penis, and by rupture both externally and into the urethra may establish a urinary fistula.

Abscess around the bulbous urethra may develop insidiously and form a hard tender nodule, or may commence with a rigor and run an acute course with fever local tenderness and pain, and rapid formation of a swelling The swelling is limited posteriorly at the middle of the perineum by the fascia of Colles, but passes forwards under cover of the scrotum. Partial or complete retention of urine is frequently present.

Diffuse Phlegmonous Periurethritis (Extravasation of Urine)

This is a virulent rapidly spreading infection with sloughing of the urethra. Stricture is usually present but is not necessarily narrow and may even be absent. The condition rarely begins as a periurethral abscess. Usually the onset is sudden and the symptoms at once become severe. After a rigor the temperature rises to 102° F., or higher, and profound toxæmia rapidly develops. The patient is pale and the skin clammy, the tongue and mouth are dry, and delirium quickly appears. The urine is passed with difficulty and in small quantity. A dull red brawny induration appears in the perineum and rapidly increases. The spread is limited by the attachment of Colles's fascia behind the transverse perineal muscle posteriorly and to the rami of the pubes laterally. The scrotum becomes red and œdematous, the penis swollen and distorted, and the infiltration rapidly mounts on to the pubes and abdominal wall. Crepitation from the formation of gas is sometimes detected. A fatal result from toxæmia is not uncommon, and may occur after operation.

Treatment.—Immediate multiple incisions should be made wherever the infection has spread and washed through several times in the twenty-four hours with hydrogen peroxide or biniodide solution (1 : 2,000). Hot fomentations should be applied, stimulants freely administered, and subcutaneous and rectal saline infusions given. Sloughing of the urethra occurs, and fistulæ form and later require treatment.

Chronic Indurative Periurethritis

There is a stricture of the bulbous urethra, usually of the irregular cartilaginous type, and large masses of fibrous induration form in the perineum and scrotum. Usually there are several urinary fistulæ and the indurated mass frequently contains one or several small abscesses. Calculi may form in the fistulæ and behind the stricture and a malignant growth has been known to develop.

Treatment.—Internal urethrotomy should be performed and a catheter tied in as a preliminary to operation on the periurethral induration a week or more later. If the stricture is impassable, external urethrotomy is undertaken at the time of the perineal operation.

A staff is placed in the urethra, and, with the patient in the lithotomy position, the indurated mass is split down the centre to the corpus spongiosum and each half dissected away, removing fistulæ and small abscesses in the substance of the mass. The opening in the urethra is repaired with catgut sutures and a catheter tied in the urethra.

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Treatment.—A penile periurethral abscess in the anterior part of the canal should be opened through the urethra with the help of a wire speculum or a short urethral tube. A perineal periurethral abscess is opened by a free median perineal incision, and the cavity flushed with biniodide solution. All pockets are opened, counter-openings made if necessary and the cavity freely drained and lightly packed with iodoform gauze. When a narrow stricture and cystitis coexist a median perineal cystotomy with drainage of the bladder should be performed.

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urethral discharge is usually present, but may consist of only a few shreds or may be absent. Tickling and crawling sensations are sometimes experienced and hæmorrhage follows instrumentation. The polypus is discovered by the urethroscope, and is removed by fine alligator forceps or the electro-cautery

Cysts

Small cysts are produced by blocking the urethral lacunæ. Cysts in the sinus pocularis are rare. A cyst of Cowper's gland or ducts may form a considerable swelling which ruptures into the urethra. The treatment consists in incision with the electric cautery through the urethroscope tube.



Fig. 557.—Malignant growth of urethra ulcerating on perineum and scrotum, and round anus.

Caruncle

Urethral caruncle is discussed at p. 7 Vol. III.

Malignant Growths of the Male Urethra

Malignant growths of the male urethra are rare. Hall collected 48 examples. In addition to these, Barney records 2 cases, and I have had 4 under my care. The condition usually occurs between the ages of 50 and 60, rarely before 40. Trauma and leucoplakia from chronic urethritis are important factors in the etiology and stricture is present in half the cases. The bulbous urethra is usually affected, less often the penile urethra, and rarely the prostatic portion. The growth takes the form of a squamous epithelioma, very seldom a sarcoma. It infiltrates and destroys the mucous membrane and invades the corpus spongiosum. Eventually fistulæ form in the perineum.

Symptoms.—The symptoms vary considerably There is increasing difficulty partly due to the fibrous stricture already present. Hæmorrhage follows the passage of an instrument, and there may be a bloody discharge without instrumentation. A purulent discharge is frequently present.

A swelling appears in the perineum in some cases, the skin becomes red, and either a fistula forms spontaneously or the swelling is incised for a simple periurethral abscess. The growth then fungates, and progressive destruction of the perineal tissues takes place (Fig. 557). In the penile urethra hard induration of the wall of the canal is felt, which slowly increases and spreads. The penis is ventrally curved during erection, and becomes swollen into a club-like form. Urethral examination shows a fibrous stricture through which the instrument may enter an irregular cavity with friable, readily bleeding walls. Urethroscopy may give a view of the growth. Lymph-glands

are affected later those along the iliac vessels and in the groins being first involved. Metastases occur in the bones, liver and lungs.

The **diagnosis** from stricture is usually difficult. Spontaneous hæmorrhage from the urethra, repeated severe hemorrhage after instrumentation, and persistent hæmaturia are important symptoms. From subacute and chronic periurethritis and from periurethral abscess the diagnosis is sometimes only made by exploratory operation.

Treatment.—Resection of the urethra has been performed in the early stage, and amputation of the penis has given good results, but when the growth is extensive complete removal of the penis (Thiersch-Gould operation) is necessary. Treatment by X rays or by radium may be adopted.

MALIGNANT GROWTHS OF THE FEMALE URETHRA

These are periurethral or urethral. The former occur after the age of 50, and the latter earlier. The urethral variety may be pedunculated or sessile, appearing as a dark red grape-like polypus or a nodular ulcerated area. The growths are squamous or rarely columnar epithelium or sarcoma. There are pain on micturition, on coitus and on sitting and walking, frequent micturition, difficulty and occasionally complete retention. Incontinence is rare. Hæmaturia is usually present. The urethra may be excised by a longitudinal incision on the anterior wall of the vagina. The vesical end is, if possible, preserved and implanted in the vaginal wall. Treatment by X rays or by radium should be used. It occasionally gives good results.

TUBERCULOSIS OF THE URETHRA AND PENIS

Tuberculosis of the urethra is rare. Primary tuberculosis has been observed, but the infection is almost invariably secondary to tuberculosis of the urinary or genital system. The female urethra is seldom affected. In the male the posterior urethra is usually attacked by spread from the prostate or the bladder. A deep tuberculous cavity may open from the substance of the prostate into the posterior urethra, or there may be superficial ulceration or tuberculous granulation tissue. The anterior urethra may show small superficial ulcers. If the penis is affected the urethral mucous membrane is involved in the tuberculous infiltration. A periurethral cold abscess may form and eventually fistulæ appear in the perineum.

Stenosis of the urethra is occasionally observed in the bulbous or female urethra in cases of urinary or genital tuberculosis. There is seldom a localized stricture, but the wall is infiltrated, and an irregular fibrous thickening results.

A urethral discharge is always present, usually thin and pale, but occasionally so abundant and purulent and associated with symptoms so acute as to suggest gonorrhœal urethritis. Hæmaturia, frequent and difficult micturition, and occasionally complete retention may be present. There is irregular periurethral induration.

Tuberculosis of the penis may be confined to ulceration of the glans, usually on the under surface or the corpora cavernosa may be invaded.

Treatment.—Urethral tuberculosis is so seldom an isolated lesion that separate treatment is rarely necessary. Stricture should be treated by internal urethrotomy and dilatation. A cold abscess is opened and tincture of iodine applied. Fistulæ are treated by scraping and injection of iodoform emulsion, bismuth paste, or iodine.

Conservative treatment should be adopted when the penis is involved, but amputation may become necessary for extensive lesions. Tuberculin may be administered.

SELECTED BIBLIOGRAPHY

Hæmaturia

Hale-White, *Quart. Journ. of Med.*, 1911, p. 509.
Klotzenberg, *Zeits. f. Urol.*, 1909, p. 125.
Newman, *Brit. Journ. Surg.*, April, 1915, p. 654.
Payne, *Surg., Gyn. and Obstet.*, 1916, ii. 76.
Pilcher, *Ann. of Surg.*, 1909, p. 652.

Congenital Abnormalities of the Kidney

Albarran, *Ann. des Mal. des Org. Gén. Urin.*, 1906, p. 1601.
Ballowitz, *Virchow's Arch.*, 1895, cxli. 309.
Helmer, *Folia Urol.*, Oct., 1908.
Judd and Harrington, *Surg., Gyn. and Obstet.*, May, 1919, p. 446.
Young and Davis, *Journ. of Urol.*, Feb., 1917, p. 17.

Movable Kidney

Billington, *Movable Kidney*, London, 1910.
Cheyne Watson, *Lancet*, April 24, 1909.
Clark and Block, *Ann. of Surg.*, Oct., 1917, p. 470.
Lane, Arbuthnot, *Lancet*, Jan. 17, 1903.
Mills and Gardiner, *Lancet*, 1914, i. 243.
Wolkow und Delitzen, *Die Wanderniere*. Berlin, 1899.

Injuries of the Kidney

Bashford, *Brit. Journ. of Surg.*, 1916, iii. No. 11.
Curschmann, *Münch. med. Woch.*, 1902, xlix. 28.
Fullerton, *Brit. Journ. of Surg.*, 1917, v. No. 18.
Noguès, Hesbet, Gauteau, *Journ. d'Urol.*, 1918, vii. 237.
Wallace, *Brit. Journ. of Surg.*, April, 1917, p. 679.

Perinephritis

Braasch, *Surg., Gyn. and Obstet.*, Nov., 1915, p. 956.
Gutierrez, *N. Y. Med. Journ.*, 1906, lxxxiii. 160.
Richardson, *Surg., Gyn. and Obstet.*, July, 1916, p. 1.
Zuckerkandl, *Wien. klin. Woch.*, Oct. 13, 1910.

Pyelonephritis and Pyelitis

Brewer, *Surg., Gyn. and Obstet.*, June, 1908, p. 609.
Cabot and Crabtree, *Surg., Gyn. and Obstet.*, xxiii., 1916, p. 495.
Campbell and Hiss, *Surg., Gyn. and Obstet.*, Dec., 1918, p. 611.
Dudgeon, *Lancet*, 1908, i. 616.
Ehrendrath and Schultz, *Boston Med. and Surg. Journ.*, 1917, ii. 10.
Kretschmer and Gaarde, *Journ. of Amer. Med. Assoc.*, 1916, i. 1093.
Morse, *Amer. Journ. of Med. Sci.*, 1909, p. 313.
Rovsing, *XV. Congrès Internat. de Méd.*, Budapest, 1910, Sec. 14, p. 11.
Sampson, *Johns Hopkins Hosp. Bull.*, 1903, No. 153, p. 336.
Thomson, *Scot. Med. and Surg. Journ.*, 1902, p. 7.
Thomson-Walker, *Pract.*, May, 1911.

Pyonephrosis

Cahn, *Münch. med. Woch.*, 1902, xlix. 19.
Gerster, *Ann. of Surg.*, 1912, ii. 1.
Greaves, *Brit. Med. Journ.*, July 13, 1907.
Morris, Henry, *Lancet*, 1910, i. 1697.
Watson, *Ann. of Surg.*, 1906, No. 2.

Renal and Perirenal Fistulæ

Heitz-Boyer et Moreno, *Ann. des Mal. des Org. Gén.-Urin.*, 1910, No. 11.

Non-Suppurative Nephritis

Edebohls, *Med. News*, April 22, 1899, and *Med. Rec.*, May 4, 1901
Herder *Med. Sci.*, April, 1920, p. 50.
Pousson, *Chir des Néphrites*. Paris, 1909.
Thomson-Walker *Pract.*, June, 1903.

Hydronephrosis

Israel, *Deuts. med. Woch.*, 1906, p. 22.
Mayo, *Journ. Amer Med. Assoc.*, 1909 p. 1383.
Pannett, *Brit. Journ. of Surg* April, 1922, p. 509.
Schloffer *Wien. klin. Woch.*, 1900, p. 50.
Thomson-Walker *Brit. Journ. of Surg.*, July 1914 p. 133.
Volcker und Lichtenberg *Beitr z. klin. Chir.*, 1907 p. 1.
Wagner *Folia Urol.*, June, 1907

Tumours of the Kidney Renal Pelvis, and Ureter

Deraniura, *N Y Med. Journ.*, 1915, ii. 1093.
Fraser *Surg., Gyn. and Obstet.*, 1916, ii. 545.
Garceau, *Tumours of the Kidney* 1909.
Grégoire, *Presse Méd.*, 1905, p. 49.
Heresco *Ann. des Mal. des Org Gén.-Urin.*, 1901 p. 655.
Israel, *Deuts. med. Woch.*, 1911, p. 57
Laughnane, *Brit. Journ. of Surg.*, July 1914, p. 77
Paschen, *Surg., Gyn. and Obstet.*, 1916, i. 544.
Schmieden, *Deuts. Zeits f Chir.*, 1902.
Walker *Ann. of Surg.*, 1897 p. 549.
Willan, *Brit. Med. Journ.*, 1915, ii. 774.
Wills and Wilson, *Collected Papers of the Mayo Clinic*, 1910, p. 419.

Cysts of the Kidney

Braasch, *Surg., Gyn. and Obstet.*, Jan., 1917 p. 61.
Gardiner *Intercol. Quart. Journ. of Med. and Surg.*, 1894, i. 147
Rocha, *Ann. des Mal. des Org Gén. Urin.*, 1895, p. 1129.
Seiber, *Deuts. Zeits. f Chir.*, 1905, p. 495.
Stromberg, *Folia Urol.*, 1909, p. 541.

Tuberculosis of the Kidney and Ureter

Braasch, *Amer Journ. of Med. Sci.*, Jan., 1920, p. 8.
Brongersma, *I Congrès de l'Assoc. Internat. d'Urol.*, Paris, 1908, p. 533.
Hallé et Motz, *Ann. des Mal. des Org Gén. Urin.*, 1906, i. 162.
Kränlein, *Folia Urol.*, 1908, p. 245.
Kümmel, *Arch. f klin. Chir.*, 1906, p. 270
Lichtenstein, *Zeits f Urol.*, 1908, p. 219.
O'Neil and Hawes, *Boston Med. and Surg Journ.*, 1913, ii. 492.
Thomson-Walker *Pract.*, May 1906.
Zuckerkandl, *Zeits. f Urol.*, 1908, p. 97

Tumours of the Suprarenal Gland

Ferrier et Lecène *Rev. de Chir* 1906, p. 325.
Garceau, *Tumours of the Kidney* 1909.
Israel, *Deuts. med. Woch.*, 1905, p. 740.

Syphilis and Schistosomiasis of the Kidney

Delamore, *Gaz. des Hôp* 1900 p. 563.
Madden, *Bilharziosis* London, 1907
Stoerk, *Wien. med. Woch.*, 1901
Sutherland and Thomson-Walker *Brit. Med. Journ.*, April 25, 1903.

RENAL CALCULUS

Brödel, *Johns Hopkins Hosp. Bull.*, 1901 p. 10
Cabot, *Journ. Amer Med. Assoc.*, 1915, ii. 1233.
Faltin, *Folia Urol.*, 1908, Hefte 3, 4.
Gage and **Beal**, *Ann. of S rg.*, 1908, p. 378.
Krotoszyner *Journ. Amer Med. Assoc.*, 1914, i. 343.
Kümmel, *Zeits. f Urol.*, 1908, p. 193.
Mayo, *Surg., Gyn. and Obstet.*, Jan., 1917 p. 1.
Newman, *Lancet*, 1909, p. 8.
Nicolich, *Surg., Gyn. and Obstet.*, Feb., 1920 p. 180.
Rovsing, *Surg., Gyn. and Obstet.*, July 1919, p. 5..

PROLAPSE OF THE URETER

Kapsammer *Zeits. f Urol.*, 1908, p. 800.
Kreisel and **Gehl**, *Surg., Gyn. and Obstet.*, Sept., 1920 p. 234
Portner *Monats. f Urol.* 1904, Heft 5.

INJURIES OF THE URETER

Albarran, *Folia Urol.*, 1908, p. 280.
Barnasconi et Colombino, *Ann. des. Mal. des Org Gén. Urin.*, 1903, ii. 1361.
Bovee, *Ann. of Surg.*, 1900, p. 165.
Peterson, *Surg., Gyn. and Obstet.*, Aug., 1920, p. 132.
Pozzi, *XIX Congrès de Chir.*, Paris, 1906, p. 168.
Rochet, *Journ. d'Urol.*, 1918, vii. 337
Scharpe, *Ann. of Surg.*, 1906, p. 687

FISTULA AND STRICTURE OF THE URETER

Boari, *Ann. des Mal. des Org Gén. Urin.*, 1909, ii. 1332.
Buerger *N Y Med. Journ.*, 1917 i. 826.
Hunner *Surg., Gyn. and Obstet.*, Jan., 1920, p. 62.
Payne, *Journ. Amer Med. Assoc.*, 1908, p. 1321.

STONE IN THE URETER

Bloch, *Folia Urol.*, April, 1909.
Braasch, *Journ. of Amer Med. Assoc.*, Jan., 1920, p. 278.
Jeanbrau, *Des Calculs de l'Urethre.* 1909.
Kidd, *Brit. Med. Journ.*, 1920 ii. 161.
Kretschmer *Surg., Gyn. and Obstet.*, Nov., 1918, p. 472; *Journ. of Amer Med. Assoc.*, Oct., 1918, p. 1355.
Rigby *Ann. of Surg.*, Nov., 1907
Thomson-Walker *Lancet*, June 17 1911.

EXTROVERSION OF THE BLADDER

Maydl, *Wien. med. Woch.*, 1894 1896, 1899.
Mayo, *Journ. of Amer Med. Assoc.*, 1917 Dec. 22, p. 2079.
Peters, *Brit. Med. Journ.*, 1902, ii. 1533.
Petersen, *Med. News* Aug 11, 1911.
Trendelenburg, *Ann. of Surg.*, 1906, p. 281

DIVERTICULA OF THE BLADDER

Barry *Proc. Roy Soc. Med.*, Surg Sect., 1911 p. 158.
Blum, *Zeits. f Urol. Chir.*, 1920, v 90.
Young, *Johns Hopkins Hosp. Repts.*, 1906, p. 401

HERNIA, INVERSION AND PROLAPSE OF THE BLADDER

Helneck, *Surg., Gyn. and Obstet.*, Jan., 1921 p. 60.
Hirokawa, *Deuts. Zeits. f Chir.*, 1911, p. 575.
Leedham-Green, *Brit. Med. Journ.*, 1906, i. 976.

INJURIES OF THE BLADDER

Cathelin, *Lyon Chir.*, Jan., Feb., 1918, 109.
Fuller *Journ. of Amer. Med. Assoc.*, 1914 ii. 1111.
Fullerton, *Brit. Journ. of Surg.*, July 1 1918.
Goldenberg, *Beitr. z. klin. Chir.*, 1909 p. 356.
Morel, *Ann. des Mal. des Org. Gén. Urin.*, 1900, p. 801
Quick, *Ann. of Surg.*, 1907 p. 91.
Report French Urological Centres, *Presse Méd.*, 191 Dec. 13. p. 700.
Thomson-Walker *Lancet* 1917 i. 1 3.

SYPHILIS OF THE BLADDER

Asch, *Zeits. f. Urol.*, 1911 p. 804.
Danforth and Corbus, *Surg., Gyn. and Obstet.*, Sept., 1920, p. 219.
von Engelmann, *Folia Urol.*, 1911 p. 47.
Frank, *II. Deutsch. urol. Kongress* Berlin, 1909 p. 350.

ACTINOMYCOSIS OF THE BLADDER

Ruhräh, *Ann. of Surg.*, 1899, p. 417
Stanton, *Amer. Med.*, 1906, p. 401

CYSTITIS

Hallé et Motz, *Ann. des Mal. des Org. Gén. Urin.*, 1902, p. 17
Hatzfik, *Journ. of Amer. Med. Assoc.*, 1914 p. 229.
Hinman, *Journ. of Amer. Med. Assoc.*, 1912, p. 1001.
Lichtenstein, *Wien. klin. Woch.*, 1907 No. 40.
Newman, *Lancet* 1912, i. 490.
Stoerk und Zuckerkandl, *Zeits. f. Urol.*, 1907 p. 3.
Thomson-Walker *Ed n. Med. Journ.*, 1914 p. 603.

TUBERCULOUS CYSTITIS

Casper *Zeits. f. Urol.* 1920 xiv 704.
Hallé et Motz, *Ann. des Mal. des Org. Gén. Urin.*, 1904 p. 16.
Karo *Med. Rec.*, Oct. 2, 1909.
Keyes, *N Y. Med. Journ.*, 1914 ii. 113.
Rovsing, *Arch. f. klin. Chir.*, 1907 p. 1.

TUMOURS OF THE BLADDER

Beer *Surg. Gyn. and Obstet.*, 1917 i. 646.
Geraghty *Surg., Gyn. and Obstet.*, 1917 i. 653; Nov., 1920 p. 410
International Labour Office Report, *Brit. Med. Journ.*, 1921 i. 645.
Judd and Sistrunk, *Journ. of Amer. Med. Assoc.* Nov 20, 1920 p. 1393.
Paschkis, *Folia Urol.*, 1906, ii. 450.
Rovsing, *Arch. f. klin. Chir.* 1907 p. 1047
Stoerk und Zuckerkandl, *Zeits. f. Urol.*, 1907 p. 1
Thomas, *Surg., Gyn. and Obstet.* 1915, ii. 133.
Thomson-Walker *Brit. Journ. of Surg.*, 1916, No. 14 p. 259.
Young, *Journ. of Amer. Med. Assoc.*, 1913, ii. 1654.

VESICAL CALCULUS

Hinton, *Brit. Med. Journ.*, 1904 ii. 833.
Kasarnowsky *Folia Urol.*, 1909, p. 460.
Keegan, *Ind. Med. Gaz.*, 1915, p. 201
Know *Zeits. f. Geb. u. Gyn.*, 1911 Heft 7
Thompson, *Surg., Gyn. and Obstet.*, Jan., 1921 p. 44.

PERICYSTITIS

Schmidt, *Surg. Gyn. and Obstet.*, 1911 p. 281

NERVOUS DISEASES OF THE BLADDER

Böhme, *Münch. med. Woch.*, Dec. 15, 1908.
Burns, *Surg., Gyn. and Obstet.*, 1917 i. 639.
Corner *Ann. of Surg.*, 1001, p. 456.
Müller *Deuts. Zeits. f Nervenheilk.*, 1901, p. 86.
Thomson-Walker *Ann. of Surg.*, 1910 p. 577; and *Zeits. f Urol.*, 1911, p. 1.

CONGENITAL MALFORMATIONS OF THE URETHRA

Beck, *Surg., Gyn. and Obstet.*, May 1917 p. 511.
Bucknall, *Lancet*, Sept. 28, 1907
Bumpus, *Journ. of Amer Med. Assoc.* Nov 29 1919 p. 1601.
Dubet, *Ann. des Mal. des Org Gén. Urin.*, 1902, No. 1.
Gutmann, *Zeits. f Urol.*, 1910 p. 575.
Keith, *Brit. Med. Journ.*, 1908, ii. 1805.
Thompson, *Surg., Gyn. and Obstet.*, Oct., 1917 p. 411; *Lancet*, 1920, ii. 790.
Young, *Journ. of Urol.* 1918, xi. 237

INJURIES AND RUPTURE OF THE URETHRA

Legueu, *Ann. des Mal. des Org Gén. Urin.*, 1907 ii. 1090.
Rutherfurd, *Lancet* Sept. 10, 1904.
Szczypiorski, *Ann. des Mal. des Org Gén.-Urin.*, 1907 ii. 1033.

STONE IN THE URETHRA

Cathelin, *Journ. d'Urol.*, 1918, vii. 267
Fenwick, *Trans. Path. Soc.*, 1890, vol. xli.
Heitz-Boyer *Presse Méd.*, Dec. 26, 1918, p. 669.
Pasteau, *Ann. des Mal. des Org. Gén. Urin.*, 1901 p. 416.

STRICTURE OF THE URETHRA

Groves, Hey *Bristol Med.-Chir Journ.*, 1910, p. 325.
Rutherfurd, *Lancet*, Sept. 10 1904.
Sawamura, *Folia Urol.*, 1910 iv 683.

NEW GROWTHS OF THE URETHRA

Barney *Boston Med. and Surg Journ.*, 1907 p. 790.
Bonzani, *Folia Urol.*, 1909 p. 491.
Hall, *Ann. of Surg.*, 1904, p. 375.
Pretswerk, *Zeits. f Urol.*, 1907 p. 273.

TUBERCULOSIS OF THE URETHRA AND PENIS

Asch, *Zeits. f Urol.*, 1909, iii. 174.
Chute, *Boston Med. and Surg Journ.*, 1903, p. 361.
Hallé et Motz, *Ann. des Mal. des Org Gén. Urin.*, 1902, p. 1404
Sawamura, *Folia Urol.*, 1910, iv 683.

THE MALE GENITAL TRACT

By RUSSELL HOWARD, C.B.E., M.S., F.R.C.S.

THE PROSTATE

Anatomy.—The prostate is a glandular organ shaped like a chestnut and weighing from 15 to 20 grm. It surrounds the first part of the urethra, the base of the bladder rests on it, and it is situated between the symphysis pubis and the rectum.

The anterior aspect of the gland is attached to the posterior surface of the symphysis pubis by specialized bands of the anterior fibres of the recto-vesical fascia forming the pubo-prostatic or anterior true ligaments of the bladder, while the lateral aspects are covered with a reflection from the recto-vesical fascia under which a large plexus of veins (the plexus of Santorini) is found. The posterior aspect is attached to the rectum by dense fibrous connective tissue in which no large vessels are found.

Many of the fibres of the levator ani muscle end on the prostate, which thus lies outside the pelvis but in the tissue that forms the pelvic diaphragm.

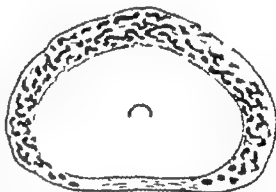


Fig. 558.—Section of normal prostate showing the prostatic plexus of veins and the capsule.

The prostatic urethra is 1¼ in. long, crescentic on section, and penetrates the prostate in such a way that a large segment of the gland lies below and a small one above it. The common ejaculatory ducts pierce the prostate, and, like the sinus pocularis and prostatic glands, open into the prostatic urethra.

The arteries of the prostate are derived from the inferior vesical artery; and the veins, which form a large plexus round the gland, enter the dorsal vein of the penis and the veins of the urethra. (Fig. 558.)

ACUTE PROSTATITIS

Acute prostatitis in the great majority of cases follows gonorrhœal urethritis or urethritis due to instrumentation of the urethra but it may occur occasionally in the course of one of the infectious fevers. The gonococcus enters the prostate through the prostatic ducts and initiates an acute inflammation, ending either in resolution, chronic prostatitis, or suppuration (See Vol. I., pp. 842, 876)

CHRONIC PROSTATITIS

Chronic inflammation of the prostate is most frequently secondary to a chronic urethritis, usually gonococcal, but may follow an acute prostatitis. The condition is a very common sequel to gonorrhœa and has far reaching consequences. The morbid anatomy shows a chronic suppuration occurring in the ducts of the prostate with interstitial fibrosis, the pus escaping into the urethra and appearing in the urine as comma shaped white threads. It is one of the causes of gleet



Fig 559—Section of prostate, showing the corpora amylacea.

The condition is discussed in Vol. I. p 877

PROSTATIC CALCULI

It is important to distinguish two separate conditions which have been described under this term. They are (a) calculi in the prostatic urethra (b) calculi in the prostate. The first are formed either in the kidney the bladder or locally in the prostatic urethra, and, becoming impacted cause difficulty of micturition. They will not be further discussed here Calculi of the second variety the true prostatic calculi, are formed in the prostate itself. In every adult prostate small bodies known as corpora amylacea are found (Fig. 559) which consist of inspissated secretion epithelial cells, and lecithin. Th y are multiple and of a colour varying from light grey to black These bodies are scarcely pathological, but become so when by infiltration with lime salts they form prostatic calculi (Fig 560) Stones in the prostate are therefore usually multiple, over a hundred having been met with in some cases and are usually small, but they may weigh as much as 120 grm. They consist of phosphate oxalate and carbonate of lime around an organic nucleus and so give a good shadow with the X rays.

Symptoms.—Calculi may exist for years in the prostate, and only be discovered on autopsy In some cases they are passed per

urethram without other symptoms. When symptoms are present they are those of cystitis of the base of the bladder viz. pain diffi culty and frequency of micturition The symptoms arise when the calculus protrudes into the prostatic urethra either through one of the ducts or by ulceration of the mucous membrane Hæmaturia may occur but it is usually slight and urethral discharge may be present. Suppuration may take place round the calculi and lead to formation of an abscess, which may burst into the urethra the perineum, or the rectum.

The **diagnosis** is made by—(1) Feeling the stones per rectum, if they are large enough. In some cases the stones may be felt to grate on one another (2) Feeling the stones in the urethra by the passage of a sound The grating characteristic of a calculus is always felt in the same place just as the sound enters the bladder In some cases combined rectal and urethral examination may lead to a correct diagnosis. (3) Radiography only a positive result being of value.

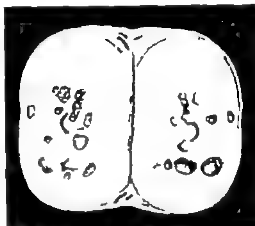


Fig. 660.—Prostate with prostatic calculi *in situ*

Treatment.—In cases of accidental discovery of prostatic calculi no treatment is necessary but if symptoms are present the prostate should be incised from the perineum and all the stones removed. Calculi in the prostate may also be reached through the bladder This viscus is opened by the suprapubic route the prostate incised, and the stones removed.

Abscesses should be treated by perineal incision, removal of the calculi, and drainage.

TUBERCULOSIS

As in tuberculosis of the other parts of the genito-urinary tract tuberculosis of the prostate is most commonly seen in young adults and in those who are disposed to the disease by heredity Chronic inflammation of the prostate due to infection by the gonococcus is another very important predisposing condition and one on which too little stress has been laid. The disease in the prostate is frequently associated with tuberculosis of the kidney bladder vesiculæ, and testis, and it is often difficult in a given case to distinguish the primary

or in parts, and the enlargement may be symmetrical or asymmetrical If enlarged as a whole it becomes more spherical, and the groove between the lateral lobes is obliterated. The enlargement may be slight and hard or very great and soft. In partial enlargements the "middle lobe" (that part between the mucous membrane of the bladder and the common ejaculatory ducts) is the part usually affected and projects into the bladder as a spherical mass or as a collar surrounding the orifice of the urethra. Such an enlargement of the middle lobe cannot be felt per rectum, although it may attain the size of a large walnut. The anterior commissure is rarely affected. (Fig. 561)

Results. (a) Effects on the urethra.—The enlargement of the prostate takes place in an upward direction, owing to the resistance of the triangular ligament, and carries the base of the bladder with it. This produces a lengthening of the prostatic urethra, so that an ordinary catheter may not be able to reach the bladder The total urethra may increase in length from the normal 8 in. to 12 in The calibre of the urethra may be altered in two ways either it may be narrowed by the pressure inwards of the enlarged lateral lobes, or it may be widened by being stretched over the mass the latter is the more common. Deviation of the urethra may also occur from excessive enlargement of one or other lateral lobes. The shape of the prostatic urethra is frequently altered by enlargement of the middle lobe so that it is more curved than usual and requires the use of a catheter with a special bend.

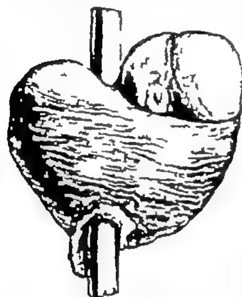


Fig. 561.—An enlarged prostate after removal by the suprapubic route. The median lobe is particularly affected.

(b) Effects on the bladder.—With the increasing difficulty in expelling the urine the muscular wall of the bladder becomes hypertrophied but this change soon reaches its limit in elderly men and is followed by dilatation of the bladder fasciculation and vesiculation with fibrosis of the muscle bundles. The projection into the bladder of the enlarged prostate causes the orifice of the urethra to be no longer the lowest part of the bladder and there is the *formation* of

a steadily enlarging postprostatic pouch behind the enlarged middle lobe. (Fig 562.)

(c) **Effects on ureters and kidneys.**—The effects on these structures are similar to those following other causes of urethral obstruction e.g stricture. The lumen of the ureter becomes dilated and its muscular coat atrophied till the tube may reach the size of a piece of small intestine. The pelvis of the kidney becomes dilated and there is an interstitial fibrosis of the kidney which destroys the secretory tubules and leads to renal insufficiency

(d) **Inflammatory effects.**—Sooner or later a cystitis develops either from direct infection by instrumentation or by infection from the bowel, and there will follow ureteritis pyelitis, and pyelonephritis.

(e) **Effects on the circulation.** — The veins of the periprostatic plexus, with which the dorsal veins of the penis communicate become dilated and varicose. Rupture of one of these may even lead to profuse hæmaturia

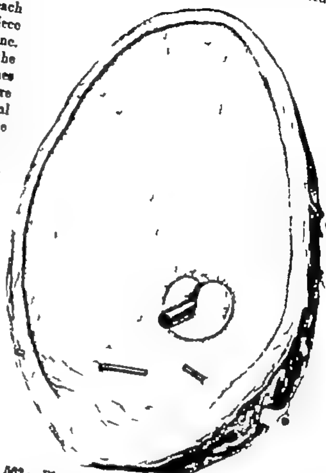


Fig 562.—Bladder laid open, showing the obstruction caused by enlargement of the prostate. A bristle is seen in each ureter and a stylet in the urethra.

(f) **Effects on the sexual organs.**—The common ejaculatory ducts which pass through the prostate may be distorted and compressed so that semen can no longer pass along them. This will lead to dilatation of the vesiculæ seminales and to aspermia.

(*g*) **Effects on the act of micturition.**—The increasing obstruction at the orifice of the urethra leads to increasing difficulty of micturition the chief difficulty being experienced in starting the act The absence of effort and the weakening of the bladder wall lead to diminished force of the stream, which is hardly projected beyond the feet. The bladder is not completely emptied by the act, and urine will accumulate (residual urine)

Symptoms.—The patient in the early stage of enlargement complains of increasing *difficulty* and also of *frequency* of micturition. The difficulty is most marked at the commencement of the act, and the patient finds that micturition is most easily performed by waiting without straining Frequency is often first noticed at night, the patient rising two or three times to empty the bladder the amount of urine voided at night is increased (nocturnal polyuria). There is loss of projection of the stream, and the patient frequently cannot micturate in the recumbent position. The difficulty of micturition is increased by cold, alcoholic or venereal excesses, constipation, or by holding the urine longer than is desirable. Increased sexual excitement and persistent erections, which may induce acts of impropriety are common. The difficulty and frequency of micturition may steadily increase until the bladder becomes constantly distended, and incontinence with overflow results, but any of the following complications may supervene and alter the clinical picture —

1. Complete retention of urine. This is due to congestion of the prostatic plexus of veins and the urethral mucous membrane, induced by cold, by venereal excess, or more frequently by prolonged holding of the urine, such as may occur on long railway journeys or at public meetings. This complication may be the first serious intimation to the patient that he has prostatic enlargement.
2. Severe hæmorrhage from rupture of a prostatic vein.
3. Cystitis, causing pain on micturition, frequency and pyuria.
4. Calculus in the bladder causing pain on micturition and hæmaturia.
5. Prostatic abscess—a rare complication.

Effects on the general health.—The general health may remain good for years, but with increasing frequency and difficulty there is impairment due to pain and loss of sleep As the bladder becomes distended and the effects of back pressure on the kidneys are felt the patient suffers from headaches, thirst, polyuria, and anorexia, and there is loss of flesh and strength. These effects are more marked if infection is added to the mechanical effects of the enlarged prostate.

Examination.—Examination per rectum may reveal a large soft prostate pressing backwards into the rectum or a firm, slightly enlarged

prostate. In both cases the enlargement is smooth and the mucous membrane of the rectum moves easily over it. One or other lateral lobe may be chiefly enlarged but the condition of the middle lobe cannot be examined through the rectum.

Examination of the urethra with a catheter reveals an obstruction to the passage of the instrument at the entrance to the bladder The urethra is found to be lengthened and the curve of the instrument has to be altered to allow it to slip past the obstruction The catheter is not gripped on removal as it is by a stricture.

The endoscope is not of much value in examination of the enlarged prostate, but the cystoscope will permit examination of an enlarged middle lobe, besides showing the condition of the bladder walls, the mouths of the ureters, and the presence or absence of pouches and calculi.

Residual urine is examined for by making the patient micturate until he thinks the bladder is emptied and then passing a catheter but several examinations are necessary as the condition fluctuates.

The condition of the kidneys can be ascertained by a careful analysis of a twenty four hours specimen of urine, by examining the blood pressure and the hæmo-renal index. The urine should also be examined for pus and bacteria.

General treatment.—The patient should carefully avoid all causes of prostatic congestion, such as alcoholic and venereal excess, constipation, bicycling, horseback riding, the use of highly spiced food and the prolonged holding of the urine. He should avoid late meals, drink freely of non-alcoholic fluid, and take as much exercise as his general condition will allow By following the rules of a regular simple life a prostatic patient may live for years in comfort, and avoid both catheterization and operation.

Catheterization.—This should only be resorted to when absolutely necessary and then under strict aseptic precautions. For acute retention the catheter must be passed (see later) for chronic retention also this instrument must be employed, but the frequency of its use varies considerably It may only be necessary to empty the bladder at long intervals (months intervening) when some slight prostatic congestion is present, but the frequency with which catheterization is required generally increases. A patient with a large bladder rarely has to pass the catheter more than twice a day but if the bladder be small and spasm of the muscle be present, more frequent catheterization is necessary "Catheter life" with the infrequent or regular passage of a catheter may be lived for years with comfort, and is consistent with great bodily and mental activity

The catheters (which of course must be carefully sterilized) should be soft and large-bored the coudé or bi-coudé being the most con

venient shape. Metal catheters should only be used if soft ones cannot be passed, and then only by the surgeon. A gum-elastic catheter of which the curve can be altered whilst in the urethra by partially withdrawing the stilette, is often serviceable.

Permanent catheterization is indicated if with cystitis catheterization is difficult, painful, or associated with hæmorrhage. A soft, self retaining catheter such as Casper's, should be passed and if the bladder is washed out twice daily may be retained for a month and then changed. At first the patient should be kept in bed, but later he may be allowed up with a suitable apparatus he should empty the bladder every two or three hours. A urethritis is always caused at first, but this soon ceases, and the catheter may be worn with comfort.

Cystitis should be treated by the administration of urinary antiseptics and by washing out the bladder and strict asepsis is essential in all instrumentation.

Operative measures.—The modern treatment of the chronically enlarged prostate consists in removal of the whole or part of the gland, either by the suprapubic or the perineal route. Whether the prostate should be removed in its entirety from its sheath, or fibromyomatous or adenomatous growths should be shelled out from the compressed prostate, is a matter of dispute, and is of little interest from the clinical point of view but the question of the selection of cases suitable for this operation is of vital importance

There can be no doubt that some patients with prostatic enlargement live for years in comfort by careful attention to their mode of life and the occasional passing of a catheter! but, on the other hand many cases do badly Difficulty in passing a catheter hæmorrhage, cystitis, attacks of acute retention, and the formation of calculi are common, and lead to much misery while the back pressure effects and infection of the kidneys tend to shorten life and render some radical treatment necessary

Complete prostatectomy in the majority of cases relieves the patient of all his symptoms and is a most successful operation, but it is not without serious risk of death from shock or hæmorrhage and important sequelæ and complications may deduct from the value of the result. It must also be remembered that in some cases—10 per cent., according to some observers—the diagnosis should be carcinoma of the prostate and the early removal may possibly result in cure, which is most unlikely if the patient is left till the diagnosis of cancer is certain. The condition of the prostate must also be considered, the large soft prostate being much more readily removed with less fear of complications, than the hard small prostate

Above all the general condition of the patient must be taken into account and more especially the state of the kidneys, as shown by

his symptoms and a careful analysis of his urine. A weak heart atheroma of the vessels, urine of persistent low specific gravity containing albumin and of low molecular concentration contra indicate the operation as do wasting thirst headache polyuria and a low hæmorenal index. Pyuria from cystitis, or unilateral pyelitis, is not a barrier to operation if the urine is of high specific gravity many cases of cystitis clearing up after the operation

To sum up, prostatectomy is indicated if a patient with a chronically enlarged prostate has to pass a catheter frequently or passes it with difficulty if the use of the instrument causes pain and hæmaturia if cystitis supervenes or a calculus forms in the bladder or if attacks of acute retention are common provided that the general condition is good and the kidneys are shown to be doing their work well. The operation is more especially indicated if the prostate is large and soft. The question of the route, suprapubic or perineal to be adopted is not yet quite settled but the balance of evidence is in favour of *suprapubic prostatectomy* and most surgeons adopt this route for all their cases. It is the easier operation and permits a more thorough exposure of the bladder its disadvantage, difficulty of drainage seldom arises.

The operation consists in opening the bladder by an incision above the pubes after the viscus has been distended with fluid incising the mucous membrane over the prostate, and then enucleating the organ with the fingers, aided by the fingers of the other hand in the rectum pushing the prostate upwards and forwards. The prostatic urethra and the common ejaculatory ducts are usually torn across. After the prostate has been removed hæmorrhage is stopped by sponge-pressure, and the bladder drained by a large tube. The after treatment consists in washing the bladder out daily the tube being removed on the third day The suprapubic wound should have closed at the end of the third week The mortality of this operation is about 7 per cent.

Two-stage operation —Patients with chronic enlargement of the prostate who show signs of renal insufficiency from back pressure should be operated upon in two stages. In the first stage the bladder is opened by the suprapubic route and drainage established by suturing a tube in the viscus by means of a purse-string suture so that a water tight closure is effected As soon as the urinary output approaches normal in quantity and quality the second stage of the operation is carried out, i e. enucleation of the prostate. The second operation usually takes place within two weeks of the first.

Perineal prostatectomy —This operation may be performed in many ways, and the primary incision in the perineum may be either a median longitudinal or a transverse one In the median perineal incision the

membranous urethra is opened, the prostatic urethra dilated, and a retractor passed into the bladder so that when it is pulled upon the prostate is drawn into the wound the fibrous sheath of the prostate is then incised, and the gland enucleated with the finger in one or more pieces. The bladder is drained by a tube, and the cavity left by removal of the prostate packed with gauze. During healing a bougie must be passed at regular intervals to maintain the patency of the urethra.

Complications of complete prostatectomy.—*Hæmorrhage* may be severe, but will usually yield to sponge-pressure and adrenalin It may however be necessary to pack the cavity left by removal of the prostate.

Infection.—Acute epididymo-orchitis may occur especially if cystitis has existed before the operation. The condition frequently ends in suppuration. Ascending pyelitis may also occur as well as hæmatogenous infection of the kidneys. *Cellulitis* of the pelvic tissue is a very occasional sequela. *Stricture incontinence* of urine and *suprapubic fistula* may all follow the operation. Inability to micturate voluntarily together with persistent suprapubic sinus, and unimpeded passage of a catheter through the urethra, implies the probable presence of torn mucous membrane hanging flap-wise over the internal urethral orifice. At the time of the prostatectomy care must be taken effectually to remove such a flap. If this complication arises the bladder wound must be opened up and the flap removed.

The *sexual power* may be lost, but this is more common after the perineal operation than after the suprapubic. Power of erection may remain but without ejaculation of semen. In some cases, lost sexual power may be regained.

Uræmia with *suppression of urine* may speedily follow operation.

Calculi may form in the pouch left after removal of the prostate.

Treatment of acute retention of urine due to enlarged prostate.—A full dose of hexamine should be given, and an attempt made to empty the bladder by catheterization If this succeeds, the bladder must be emptied regularly until the power of spontaneous micturition is regained. A second attack of retention should not be allowed to occur If regular catheterization is impossible, a catheter should be tied into the bladder for a day or two.

If catheterization fails, the bladder should be aspirated above the pubes after a small incision has been made through the skin then another attempt should be made to pass and tie in a catheter If, after two or three suprapubic aspirations, attempts to catheterize fail, the bladder should be drained through a suprapubic incision, and a day or two later the prostate removed by this route.

NEW GROWTHS

Benign growths of the prostate only exist as the adenomas and fibromyomas of chronic enlargement, and have been considered under that heading (p. 957).

Malignant growths of the prostate consist of sarcoma and carcinoma of which the latter is by far the more common.

SARCOMA [1]

Sarcoma of the prostate is rare but it occurs at all ages, even sometimes in infants It is invariably primary

Symptoms.—There is an increasing difficulty in passing urine, with more or less sudden complete retention Occasionally hæmaturia and pyuria are present and fragments of growth may be passed per urethram On rectal examination the growth is felt projecting backwards into the rectum as a large firm mass, over which the mucous membrane does not move freely Involvement of the pelvic glands is late, but metastasis in the lungs and other organs is common the disease being invariably fatal.

Treatment.—This is similar to the palliative treatment of carcinoma of the prostate (p. 967). Attempts at removal can be made but are usually followed by rapid local recurrence

CARCINOMA [2] (Fig 563)

Pathology.—In the prostate as in other parts of the body the cause of carcinoma is unknown It has been stated that malignant disease not infrequently commences as chronic enlargement, but proof of this is wanting, and it is more likely that the cases were carcinomatous from the first. Chronic gonorrhœal inflammation has also been assigned as a cause, but on insufficient evidence.

Pathologically the disease can be divided into soft (medullary) and hard (scirrhus) types, according to the amount of fibrous tissue in the growth but of more importance is the clinical division into—

(a) Growths which for a long time resemble innocent enlargements, and are frequently removed under that idea, the diagnosis being established by the microscope and the after-history

(b) Growths which, having rapidly infiltrated the surrounding tissue fungate into the bladder and rectum and involve the pelvic glands early so that the pelvis soon becomes filled with a carcinomatous mass. These cases are the diffuse prostato-pelvic carcinomas of Guyon.

(c) A rare form of growth which is followed by general carcinomatous invasion of bone, the primary growth in the

[1] *See also* Vol. I., p. 540. [2] *See also* Vol. I., p. 500.

prostate being small and often difficult to discover The secondary growths occur in the bone-marrow especially of the vertebræ, of the lower end of the femur and of the humerus, and gradually destroy the bone, leading in some cases, to multiple spontaneous fractures. Secondary growths in internal organs are rare but carcinoma of the prostate in man is sometimes associated with general carcinomatosis. Secondary carcinoma of the prostate is rare and it is unusual for bladder growths to invade the prostate, although invasion of the bladder by prostatic carcinoma is the rule.



Fig 563. —Section of the bladder prostate and rectum, showing carcinoma of the prostate the bristle is in the common ejaculatory duct.

Symptoms.—In an early stage of carcinoma of the prostate the symptoms are similar to those of chronic enlargement, viz. difficulty and frequency of micturition loss of projection of the stream retention of urine, and finally the incontinence of overflow but there may be important differences, and afterwards other symptoms are added In the first place, it may be stated briefly that the symptoms of carcinoma are much more rapidly and steadily progressive than those of chronic enlargement, and that the interference with micturition is more pronounced than the physical signs would lead one to expect

Pain is often a more marked and earlier feature in malignant disease than in chronic enlargement. It is referred to the end of the penis, to the hypogastrium and the perineum and although increased by micturition is not relieved after it It is also very resistant to

treatment being due to infiltration of the nerve plexus by the carcinomatous growth With involvement of the sciatic nerves pain extending down the leg occurs.

True incontinence of urine may be set up in carcinoma due to destruction of the bladder sphincters, but only towards the end of the disease.

Hæmaturia is rare unless there is ulceration of the growth but it has nothing to distinguish it from the other causes of bladder hæmorrhage. As a rule it is slight. Pieces of growth may be passed per urethram.

Pyuria is always present when the growth has ulcerated into the bladder but the cystitis rarely reaches a severe degree.

Interference with defæcation is similar to that occurring in cases of simple enlargement but may go on to complete obstruction Ulceration into the bowel leads to hæmorrhage and discharge per rectum

Cachexia is marked and occurs early It is not relieved by feeding and by treatment of the symptoms of urinary infection as in cases of simple enlargement.

Physical signs.—The prostate should be examined per rectum after taking the precaution to empty the bladder In a well marked case it is always much enlarged and the surface presents pronounced irregularities, which are usually hard and nodular Hard conical projections can often be felt extending along the vesiculæ seminales or along the wall of the pelvis the glands in the pelvis can frequently be felt to be enlarged and hard. The rectal mucous membrane is often not freely movable over the tumour but is so in the earlier stage.

Examination of the urethra and the bladder by the catheter sound or cystoscope is contra indicated, if the diagnosis can be made by rectal examination as likely to cause severe hæmorrhage and cystitis. If examination of the urethra is carried out, only soft instruments should be used. The cystoscope is difficult to pass, and gives little information especially as bleeding may rapidly obscure the view In a few cases the growth resembles a vesical tumour but a differential diagnosis is at once made on rectal examination Late in the disease complete retention of urine, rectal obstruction involvement of the ureters, with subsequent hydronephrosis and pyonephrosis, anæmia and secondary deposits, occur whilst hypostatic pneumonia is frequently the direct cause of death.

Treatment.—In the great majority of cases palliation of the symptoms is the only treatment possible The pain should be relieved by morphia antipyrin, hot bottles and hot applications. For the retention of urine, catheterisation with *soft* catheters is permissible if

their passage does not cause severe pain and hæmaturia, but if it does so a permanent suprapubic opening should be made. All local treatment should be put off as long as possible, as it will only hasten retention of urine, cystitis, and hæmaturia.

Radical treatment.—Operations for removal of the prostate the seminal vesicles, the vasa deferentia, and the trigone of the bladder as far as the entrance of the ureters have been devised Young following the perineal route, and McKellop and the author working partly by the suprapubic route and partly by the perineal. Absence of recurrence with a fair degree of urinary control has been reported as long as four years after the operation.

Removal of a carcinomatous prostate is sometimes carried out, under a mistaken diagnosis of chronic enlargement, by the suprapubic route, but rapid recurrence is almost inevitable, and the danger of death from hæmorrhage considerable.

NEUROSES

Nervous disturbances of the prostate are of three kinds—hyperæsthesia of the gland, hyperæsthesia of the mucous membrane of the prostatic urethra, and spasm of the muscular fibres of the prostate causing difficulty in micturition All three are usually found combined in the same patient.

Prostatic neuroses usually occur in young adults who have either had an inflammatory condition of the urethra and prostate, and often much treatment for it, or who are neurasthenic and have indulged in masturbation or sexual excesses.

In the first variety of neurosis the patient complains of a feeling of fullness or weight in the perineum often occurring in attacks. On examination of the urine no prostatic threads or abnormal contents are found but rectal examination shows the prostate to be very tender

If the neurosis affects the prostatic urethra similar symptoms are present, and the passage of a catheter causes severe pain as the instrument enters the bladder The urethra, however shows no sign of inflammation and there is no discharge.

The spasmodic variety of neurosis of the prostate is the most frequent of the three and is characterized by difficulty in micturition especially in the initiation of the act, the difficulty varying from time to time As a rule it is exaggerated by the presence of others, but it may be present and necessitate straining even when the patient is alone The passage of a catheter after the bladder is supposed to have been emptied will often demonstrate residual urine, but presents no difficulties except a slight one at the neck of the bladder The spasmodic obstruction is distinguished from those due to organic stricture of the urethra or to prostatic enlargement, by the facts that there

is no lengthening of the urethra that the difficulty varies from time to time and that a large catheter passes more readily than a small one The condition may be associated with attacks of spasm of the detrusor muscle of the bladder causing urgent micturition without pain or difficulty

Treatment.—Any inflammatory condition of the urethra or prostate should be attended to and the patient assured of the absence of serious disease Too much local treatment especially if it be painful is harmful as tending to increase the neurosis. Passage of a large sound daily with the general treatment of neurasthenia, will often result in cure

THE VESICULÆ SEMINALES

ACUTE VESICULITIS (SPERMATO-CYSTITIS)

Acute vesiculitis is most commonly secondary to acute urethritis the usual cause being infection by the gonococcus, but it may follow septic urethritis induced by instrumentation of the urethra Other causes are prostatitis, cystitis and suppuration after removal of the prostate The symptoms and treatment are dealt with under Gonorrhœal Spermato-Cystitis Vol. I p 879

CHRONIC VESICULITIS (SPERMATO-CYSTITIS)

Chronic vesiculitis may be gonorrhœal septic, or tuberculous. The first two may be considered together

Chronic Septic or Gonorrhœal Vesiculitis

This condition usually follows a urethritis of a similar nature and is not infrequently preceded by an acute attack

Symptoms.—There is a feeling of weight and pain in the perineum, and frequently also a chronic urethral discharge which on endoscopic examination is found to come from the ejaculatory ducts There may be frequency and pain on micturition and sexual irritability leading at first to increased sexual desire and power and later to diminution of the sexual appetite and to impotence. On rectal examination the vesiculæ are found to be enlarged and painful and pus can frequently be squeezed from them into the urethra Chronic urethritis and prostatitis are often concomitants.

Treatment.—The only rational treatment for this condition besides the administration of urinary antiseptics, is the emptying of the vesiculæ of their abnormal contents by digital manipulation The vesiculæ are stroked from above downwards, their contents being squeezed into the urethra This is repeated daily until relief of all symptoms is obtained but the condition is very rebellious to treatment.

In old-standing cases it may be justifiable to remove the vesiculæ through a perineal incision.

TUBERCULOUS VESICULITIS (Fig 564)

Tuberculous vesiculitis is usually associated with tuberculous disease in other parts of the genito-urinary tract, especially in the epididymis and the prostate. It has, however been stated that primary disease is not uncommon and that the tuberculous disease of the epididymis is secondary to vesiculitis.

Symptoms.—The condition is usually discovered during routine rectal examination in cases of tuberculosis of the testis, prostate or bladder but in some cases the first symptom may be the appearance of a chronic abscess in the perineum There are frequency of micturition a feeling of weight in the perineum and occasionally a urethral discharge.

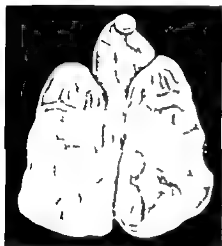


Fig 564 —Section of a vesicula seminalis, showing advanced tuberculosis.

On rectal examination the vesicula in the early stages feels hard and nodular but later the nodules soften, and in advanced cases a soft fluctuating swelling is felt.

Treatment.—The form of treatment is largely determined by the condition of the other parts of the genito-urinary tract In cases of tuberculous disease of the testis submitted to epididymectomy or castration the corresponding vesicula if diseased should be removed at the same operation by perineal section and this plan should also be followed if primary disease of the vesicula is diagnosed. In cases of advanced genito-urinary tuberculosis, general treatment is all that is indicated. Tuberculous abscesses should be opened from the perineum and the contents carefully scraped out

CYSTS CONCRETIONS AND NEW GROWTHS

Cysts of these organs have been described and are usually considered to be retention cysts due to stricture of the duct. Stricture of the common ejaculatory duct is very rare and it is probable that most cases of alleged cysts of the vesiculæ have little to do with these receptacles.

Concretions have been found in connexion with chronic vesiculitis but they are very rare

New growths are usually secondary to disease of the prostate primary new growths are so rare as to be pathological curiosities

THE TESTIS

CONGENITAL ABNORMALITIES

POLYORCHISM

The majority of reports of cases of polyorchism are untrustworthy but several definite cases of this rare condition have been described Only cases verified by dissection and microscopical examination should be admitted for encysted hydroceles omental hernia, etc have all been described as supernumerary testes

ANORCHISM—MONORCHISM

These cases are more frequently met with than cases of polyorchism but the condition still remains very rare The testis alone may be absent *or any or all parts of the sexual apparatus on one or both sides.* The condition is usually associated with abnormalities of the external sexual apparatus.

ANTERIOR INVERSION

Several forms of inversion of the testis have been described but anterior inversion is the only one of interest It is said to occur in one in every twenty males. With anterior inversion the body of the testis and the tunica vaginalis are posterior whilst the epididymis is anterior If not recognized, the condition may lead to errors of diagnosis, or more important still to injury of the testis in the tapping of a hydrocele if the position of the testis has not been carefully ascertained beforehand.

IMPERFECT DESCENT

In the early stages of development the testis is situated in the abdomen below the kidney and it is only in the seventh and eighth months of fœtal life that it descends into the scrotum. The descent of the testis is governed by the gubernaculum testis, a fibro-muscular bundle with attachments above to the lower pole of the testis the globus minor of the epididymis, and the cæcum and below to the skin at the bottom of the scrotum and over the perineum the symphysis pubis, and the anterior superior spine of the ilium In the course of its normal descent the testis passes through the inguinal canal its arrest at any point constitutes *the imperfectly descended testis* its

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departure from the normal direction, into that of some of the non scrotal fibres of the gubernaculum, *the ectopic testis*.

The testis may therefore be situated in the abdomen in the inguinal canal just outside the external ring, or in the perineum over the symphysis pubis or near the anterior superior spine. The testis has also been found in Scarpa's triangle, having passed into the thigh over Poupart's ligament after it had issued from the external abdominal ring. The cause of imperfect or abnormal descent is unknown, but it is probably intimately connected with development of the testis, as the incorrectly placed organ is nearly always undeveloped and functionless as far as the secretion of spermatozoa is concerned; even if spermatozoa are found in the semen of a cryptorchid it will only be at puberty or soon after the imperfectly descended gland undergoing premature atrophy.

In all cases of imperfectly descended testis the processus vaginalis is to be found in the scrotum, but the upper end does not become shut off from the general peritoneal cavity and the patient always has a potential or an actual inguinal hernia. Fluid may collect in the peritoneal pouch and form a congenital hydrocele.

Diagnosis.—The diagnosis of imperfectly descended testis is made by finding the scrotum empty and unless the gland is actually intra-abdominal, by feeling the organ in its abnormal position. Obvious as such a condition would appear to be, mistakes are made in the case of young children with very mobile testes. In these children the slightest stimulus, such as slight coldness due to removal of the clothing, will cause the testis to be retracted into the inguinal canal and casual examination will lead to error. In imperfect descent the organ cannot be made by manipulation to reach the bottom of the scrotum, but the merely extremely mobile testis can readily be pressed down into its proper place.

Treatment.—In considering treatment, the value of the organ and the dangers of the condition must be taken into consideration. It has already been pointed out that the imperfectly descended testis is an ill-developed gland usually incapable of spermatogenesis, but this does not necessarily mean that it has no function. As is well known, removal of both testes in a young subject prevents the development of the secondary male characteristics, probably owing to lack of the internal secretion of the testes but development of these characteristics does occur in cryptorchids showing that the internal secretion is normal. At the same time, it is also well known that one testis is sufficient for the purposes of development, and therefore the loss of the internal secretion of one imperfectly descended testis may be ignored. From the physiological point of view consequently there is no benefit to be gained from saving one imperfectly descended testis

nor will the placing of such a testis in the scrotum lead to its developing active spermatogenesis. Further the imperfectly placed organ is especially liable to certain accidents and diseases. In the perineum, in the inguinal canal, in front of the pubes, or in Scarpa's triangle it is particularly liable to injury from blows and subsequent inflammation and atrophy. The abnormal attachments of the epididymis and its mesentery may lead to torsion, whilst malignant disease is relatively more common in the imperfectly descended than in the normally placed testis.

The fact that imperfect descent is complicated by a patent processus vaginalis, and that radical cure of hernia is easier and more certain after removal of the testis, must also be taken into account. At the same time it must be remembered that at puberty a testis that has remained in the inguinal canal will *sometimes* descend into its normal situation in the scrotum.

In all cases, except those in which the testis is in the abdomen, operation is indicated, and the organ can either be (*a*) fixed into the scrotum, (*b*) removed, or (*c*) returned to the abdomen.

(*a*) **Orchidopexy** is only possible in the exceptional cases in which the spermatic vessels are long enough to reach the bottom of the scrotum without tension, whilst attempts to increase the length of the *spermatic cord* by division of structures and inversion of the testis usually lead to atrophy of the organ. The operation of orchidopexy is therefore only indicated in exceptional cases. Complete atrophy and re-ascent of the testis are common, and the results of the operation are usually disappointing. The steps of the operation are as follows. An incision is made over the external abdominal ring as in Bassini's operation for inguinal hernia, and the external oblique aponeurosis divided and opened. The *processus vaginalis testis* is then identified and opened, and the testis exposed. The peritoneal process is divided above the testis, and the upper end carefully separated from the structures of the spermatic cord and ligatured as in a hernia operation. The testis and spermatic cord are then lifted from their bed, pulled downwards, and all bands of fascia carefully divided until the cord is so long that the testis will lie on the thigh three or four inches below Poupart's ligament. If this lengthening cannot be obtained by division of the fascia only, the spermatic vessels must be divided, and the testis left attached merely by the vas and artery of the vas. The forefinger is then passed into the scrotum, and a pocket for the testis made there. Into this pocket the *testis* is placed, and held in position by a purse-string suture passed through the tissues above. The conjoined tendon of the internal oblique and transversalis is then sutured to Poupart's ligament above the vas, and the other layers of the abdominal wall are closed as in a radical cure of hernia.

(*b*) **Removal of the testis.**—This is the operation usually performed for imperfect descent on one side, especially if the case is complicated by hernia or torsion but when these complications do not exist, little harm is likely to result from waiting for the onset of puberty on the off-chance of descent occurring at that time.

(*c*) **Returning the testis to the abdomen.**—This can be done when both testes are imperfectly descended so that the internal secretion may not be lost but it must be remembered that torsion and malignant disease are more apt to occur in these organs and that the extension of any inflammation from the urethra is more dangerous in an abdominal than in a scrotal testis.



Fig 563.—Torsion of the spermatic cord.

The hernia which so frequently complicates imperfect descent of the testis should always be treated by radical cure trusses designed to allow the descent of the testis whilst retaining the hernia are useless. When the radical cure is performed the testis should be removed to permit more complete and more secure closure of the inguinal canal If the condition is bilateral, one or both testes should be returned to the abdomen.

TORSION OF THE SPERMATIC CORD (AXIAL ROTATION OF THE TESTIS)

Torsion of the spermatic cord (Fig 565) is associated with developmental errors of attachment of the epididymis and the common mesentery to the testis, and these errors are more frequently found in the imperfectly descended organ than in one normally placed in the scrotum. The rotation usually takes place at the globus minor and is of such a nature that the testis is inverted and the globus major and hydatid are found below The twist may be half a turn but as many as four turns have been described Although this condition is always associated with errors of development the exciting cause of the rotation is unknown, some cases occurring during violent exercise others during sleep Clinically the cases may be divided into acute and recurring

Acute Torsion

Symptoms.—The patient, usually the subject of an imperfectly descended testis, is suddenly seized with violent pain in the groin,

vomits, and becomes collapsed the symptoms and physical signs closely resembling those of acute strangulated hernia In the groin a firm, tender oval lump is felt which cannot be separated from the abdomen and which has no impulse on coughing The scrotum on the side of the lump is empty and the skin usually red and œdematous Fluid which is generally blood stained, may be found in the vaginal cavity

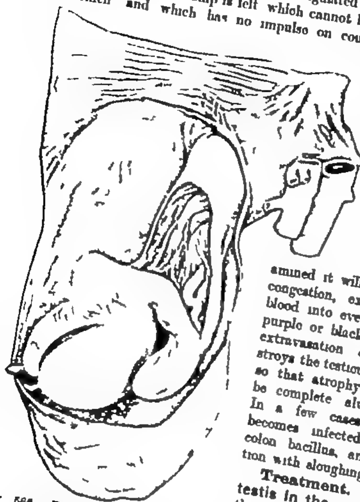


Fig 566.—Dissection of an imperfectly descended testis, showing the condition which is liable to result in torsion.

Results.—If the testis be removed and examined it will show extreme congestion, extravasation of blood into every part and a purple or black colour This extravasation of blood destroys the testicular substance so that atrophy which may be complete always follows. In a few cases the organ becomes infected with the colon bacillus, and suppuration with sloughing results.

Treatment. (a) **With testis in the scrotum**—If the case is seen soon after the rotation has occurred an attempt should be made to untwist it. This has been successful in a certain number of instances but success does not always avert subsequent atrophy If the attempt to untwist is not successful the testis should be exposed and removed although if the twist is slight and the extravasation of blood not excessive an attempt to save the testis may be made

(b) **With imperfectly descended testis** (Fig 566)—In these cases the testis should be removed the processus vaginalis separated and ligatured, and the internal abdominal ring closed.

the urethra and prostate, the passage and impaction of calculi in the urethra the bursting of abscesses from the vesiculæ, prostate and Cowper's glands into the urethra, or in association with infection with B coli of the urinary tract. Urethritis due to organisms other than the gonococcus is not infrequently followed by an epididymo-orchitis which has the same symptomatology and physical signs as that due to the gonococcus and at first demands similar treatment.

Prognosis.—Although the majority of cases of infective epididymo-orchitis end either in resolution or in fibrosis, a large number go on to suppuration. This pus-formation may occur in one of three places

(a) *In the tunica vaginalis*—This is perhaps the most common place, the fluid present in the tunica in all cases of acute epididymo-orchitis becoming more or less purulent. The redness and œdema of the skin are most marked in front of the testis, where a fluctuating swelling forms, from which pus is evacuated. This condition does not lead to fungous testis or to atrophy unless it is coexistent with suppuration in the testis.

(b) *In the body of the testis*—Owing to the dense tunica albuginea, suppuration in the body of the testis is frequently associated with gangrene and sloughing of the organ The body is much enlarged and if incisions are not made into it the pus bursts externally frequently through several fistulæ. Complete atrophy of the testis is a common sequel.

(c) *In the epididymis*—If suppuration occur in the epididymis a fluctuating swelling forms at the lower and posterior part of the scrotum After the discharge of the pus, healing occurs by fibrous tissue, and the secretion of the testis is usually lost to the semen.

Treatment. 1 The urethritis—The patient should be given urinary antiseptics and sedatives such as hexamine, hetralin buchu, acid sodium phosphate etc. and encouraged to drink freely of bland fluids If injections of astringents and antiseptics into the urethra are being used it is probably wise to discontinue them

2. General treatment.—While the condition is acute the patient should be confined to bed on a light diet and the bowels freely opened the more complete the rest in bed the sooner will resolution occur Drugs such as morphia, antimony tartrate anemone pulsatilla, salicylate of soda etc., may be given for the relief of pain. Vaccine therapy has also been employed with some success.

3. Local treatment—The testis should be well supported either by a good suspensory bandage or if the patient is in bed on a small pillow For the first forty-eight hours cold may be applied either by means of an ice-bag or by evaporating lead lotion but

warmth in the shape of fomentations equally relieves the pain and probably is of more value in promoting resolution.

If a hydrocele be present and the pain intense relief can frequently be obtained by puncturing with a tenotomy knife and allowing the escape of fluid. Counter-irritation by painting the scrotum with silver nitrate (1 dr. to 1 oz.) till smarting is complained of will often relieve the pain and allow the patient to get about if this is necessary. Bier's method of passive congestion can also be tried. As soon as the acute stage is over the testis should be carefully strapped to promote absorption of the inflammatory products, and the strapping with suspension of the testis should be continued until all thickening has disappeared. This treatment, combined with the giving of potassium iodide should also be carried out for simple chronic epididymo-orchitis.

If suppuration occur the abscess should be carefully opened over the most prominent part. Great care should be taken in opening an abscess in front of the scrotum as the pus is frequently confined to the cavity of the tunica vaginalis and a careless incision may open the tunica albuginea and infect the testis.

Incision into the testis with a tenotomy knife has been advised in the early stages of epididymo-orchitis even in gonorrhoeal cases. The proceeding is not without danger and is probably useless. Excision of the fibrous nodules of chronic epididymo-orchitis has been done but the results as regards sterility are doubtful. In cases of gangrene the organ should be excised and the scrotum drained.

Coli Epididymo-Orchitis

Acute epididymo-orchitis is not infrequently seen in cases of infection of the urinary passages with the colon bacillus, and the inflammation may be recurrent. In symptoms, treatment and results it does not differ from other varieties of acute epididymo-orchitis. The diagnosis of the cause is very apt to be mistaken and the condition ascribed to gonorrhoea in spite of the denials of the patient or to injury and strain during work. The diagnosis is made by a careful bacteriological examination of the urine.

ORCHITIS

Orchitis may occur as a secondary affection to epididymitis, or the inflammation may primarily affect the body of the testis, the epididymis being only slightly involved. Orchitis is much rarer than epididymo-orchitis and is due to injury, gout or infection by one of the organisms of the specific diseases, particularly epidemic parotitis (mumps), typhoid fever, smallpox, scarlet fever and possibly rheumatism and influenza.

Traumatic orchitis has been considered under Injuries of the Testis (p. 970).

Gouty Orchitis

Inflammation of the body of the testis due to gout is very rare, but the possibility of its occurrence may be considered settled An acute or subacute orchitis develops without any apparent cause, usually in a patient who is middled-aged and gives a history of attacks of articular gout. The course of the disease is tedious, as relapses are apt to occur The epididymis is only slightly affected but a condition of epididymo-orchitis secondary to gouty urethritis has also been described.

Treatment.—The treatment consists in supporting the testes and in the local application of warmth, combined with the medicinal treatment of the gouty diathesis.

Orchitis of Epidemic Parotitis

This variety of orchitis usually develops between the sixth and the eighth day of the parotitis, and is much more common in some epidemics than in others. It occurs in boys and young adults, being almost unknown in childhood or old age. It may occur in an epidemic without the development of parotitis, or it may precede the parotitis in some cases it has developed after inflammation of the submaxillary gland, without any involvement of the parotid. The condition is mainly an orchitis, but cases of epididymitis have been described.

Symptoms.—The body of the testis becomes tender hard, and painful. The skin of the scrotum is red, and there may be a secondary hydrocele The condition, though usually unilateral, may be bilateral. The orchitis usually clears up rapidly four days being the average duration of the disease but in some cases atrophy follows. This is particularly apt to occur in older patients, and is more common in some epidemics than in others. Should it occur in both testes, impotence or even infantilism may result.

Treatment consists in rest in bed, warmth, and support of the testes. The patient should remain in bed till all the swelling has disappeared.

Orchitis of Typhoid Fever

Orchitis occurring in typhoid usually appears during the height of the disease, but it has been known as early as the seventh day or it may occur during convalescence. It is a rare complication. The inflammation is usually subacute, and may not be noticed owing to the general condition of the patient. The body of the testis becomes hard, tender, and swollen, and then gradual resolution takes place suppuration and atrophy although not unknown, are rare. One testis only is usually attacked.

Orchitis of Smallpox

Orchitis is a rare complication of smallpox, but it occasionally terminates in suppuration. It has also been described following vaccination for smallpox.

Orchitis of Scarlet Fever, Influenza and Malaria

Orchitis is an extremely rare complication of these diseases, but its possibility should be remembered in seeking for the origin of an otherwise unexplained orchitis.

Orchitis and Rheumatism

The cause of rheumatism is still uncertain, and it is doubtful if rheumatic orchitis really exists. Polyarthritis is very frequently of gonorrhœal origin, and it is possible that cases described as rheumatic are really cases of epididymo-orchitis secondary to gonorrhœal urethritis which is complicated by gonorrhœal arthritis.

Orchitis has also been said to have complicated tonsillitis, but the latter affection may be due to such different causes that discussion of the subject is unnecessary.

Epididymo-Orchitis and Strain

The connexion, if any, between epididymo-orchitis and strain is one of great importance, as it is not infrequent for workmen to claim compensation for an attack of epididymo-orchitis which is alleged to have followed the lifting of a heavy weight. Whether epididymo-orchitis is ever due to strain is doubtful. It has been suggested that violent contraction of the cremaster muscle due to great muscular effort may cause the testis to strike so forcibly against the pillars of the external ring as to produce an acute epididymo-orchitis, but this is difficult of proof. Cases of epididymo-orchitis of obscure origin are not very uncommon, and it is easy to attribute them in the absence of an obvious cause to an alleged strain but great care should be taken to exclude all other possible causes before this is suggested. Many cases are due to gonorrhœal urethritis, the discharge ceasing for a time when the testes are attacked. Others are cases of acute tuberculous or of infection with B. coli, or are due to subacute torsion of the spermatic cord. This last condition was not recognized by the older writers on diseases of the testis, and accounts for many cases of acute epididymo-orchitis of apparently unknown cause. Acute torsion of the spermatic cord may follow a muscular effort, which may thus be the exciting cause of the torsion, the predisposing cause being a congenital abnormality of the attachments of the testis (see p. 974).

Some cases of epididymo-orchitis may be due to thrombosis of the veins of the pampiniform plexus. I have a specimen of this condition. The onset was acute, with symptoms of acute epididymo-orchitis, and after this had subsided a hard lump was left in the scrotum just above the body of the testis. The testis was excised under the impression that the lump was a malignant tumour, but after removal the condition of thrombosed veins of the pampiniform plexus was obvious.

Tuberculous Epididymo-Orchitis

Tuberculous epididymo-orchitis is usually associated with tuberculosis in other parts of the genito-urinary tract, especially the vesiculæ seminales and the prostate. The disease may however be most advanced in the testis, and it is probable that in some cases the tuberculosis is localized in this organ, the organisms reaching the affected part by the blood-stream The epididymis is usually attacked before the body of the testis (Fig 567) perhaps for months before the body is affected Infection of the epididymis can occur in one of two ways—either the organism has infected the vesiculæ, prostate, or urethra and reaches the testis by spreading along the lymphatics of the vas deferens or it reaches the testis by the blood stream. Both these methods may occur but probably the infection is most commonly conveyed along the vas from the vesiculæ, which can usually be shown to contain tubercle bacilli in cases of tuberculous epididymitis.

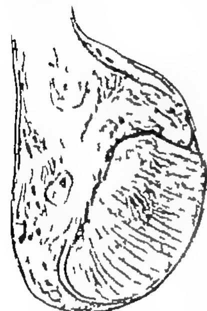


Fig. 567 —Early tuberculosis of the epididymis.

The disease occurs at all ages, but is most common in young adults between the ages of 20 and 30 years, and it has the usual etiology of tuberculosis.

Varieties.—Clinically it is possible to distinguish two forms, an acute and a chronic The *acute* variety has a sudden onset, with severe pain and swelling of the epididymis, the symptoms and physical signs closely resembling those of acute epididymo-orchitis of gonorrhœal origin. From this it can be diagnosed by the absence of urethral discharge or in the rare cases in which this is present by isolating the tubercle bacillus from the exudate

The *chronic* variety of tuberculous epididymo-orchitis is the more common (Fig 568) and is insidious in its onset. Usually the first thing noticed by the patient is a small painless nodule in the back part of the testis, associated with a slight aching pain in the part On examination this nodule is usually found to be in the globus minor of the epididymis, but not infrequently it is situated in the globus major This difference of situation may be explained by the

two modes of infection Thus, if the infection spreads along the vas, the globus minor is first affected but in blood borne infection the globus major suffers first the spermatic artery entering the epididymis near the upper end.

Signs.—When the disease is moderately advanced it presents the following physical signs The skin of the scrotum tends to be adherent to the lower and posterior aspect of the testis later a fluctuating swelling will form at this point burst and discharge pus. The epididymis is enlarged and nodular the nodules at first being firm but later becoming softened in the centre The vas is often normal but sometimes small palpable nodules are present so that it feels beaded. The rest of the cord is normal, but is sometimes infiltrated with inflammatory products, especially in cases of mixed infection. The body of the testis appears on clinical examination to be normal, but after removal small tubercles can usually be seen in it, especially numerous near the mediastinum testis.



Fig 568.—Advanced tuberculosis of the epididymis and body of the testis.

A small hydrocele is present in about 30 per cent of the cases, but is not a prominent feature. On rectal examination, nodules of tuberculous deposit can frequently be felt in the vesiculæ and prostate, and there may be evidence of tuberculous disease of other parts of the genito-urinary tract especially in the other testis. The disease, if not treated, usually becomes bilateral although it is generally more advanced on one side

Prognosis.—The prognosis of *acute* tuberculous epididymo-orchitis is bad the inflammation as a rule rapidly terminating in suppuration and sinus-formation. In the acute cases also the body of the testis is affected early and severely

The prognosis of the *chronic* variety is better the inflammation frequently terminating in fibrosis (Fig 569) but in the majority of cases suppuration occurs sooner or later The prognosis as regards the life of the patient depends on the involvement of other parts of the genito-urinary tract.

Treatment. Acute cases.—The prognosis in the really acute case is so bad as regards saving the testis that castration should be advised as soon as the diagnosis is made, provided the disease is not advanced in other parts of the genito-urinary tract

If the patient will not agree to this he should be put to bed, the testis well supported and the general treatment of tuberculosis carried



Fig 569.—Tuberculosis of the testis ending in fibrosis.

It is difficult to distinguish epididymis from body and both are firmly adherent to the skin. The condition closely simulates malignant disease.

out. If suppuration occur consent for removal of the testis will often be given but if not the abscess should be opened and the disease eradicated as far as possible. Epididymectomy is not indicated in acute cases, as the body is invariably affected.

Chronic cases.—The usual constitutional treatment for tuberculosis should be carefully carried out and beyond supporting the testis in a suspensory bandage no local treatment is necessary Treatment by injection of tuberculin has proved of value and should always be tried in chronic cases. Bier s method of passive congestion has also

been used with success in cases of tuberculous testis and may be given a trial before more radical methods are tried If general treatment fails and the condition goes on to suppuration one of the three following operations may be advised —

(a) The abscess is opened and the diseased parts are thoroughly scraped with a sharp spoon so as to remove as far as possible all tuberculous tissue This may be followed by healing, and the testis is saved although its function is lost Frequently however a sinus persists and further treatment becomes necessary

(b) *Epididymectomy*—In this operation the diseased epididymis is dissected off the body of the testis care being taken to save the vessels and an attempt made to obtain healing by first intention. The vas in suitable cases may be anastomosed to the testis but it is doubtful whether it will become functional. The procedure has the advantage of leaving the patient his testis but the advantage is a sentimental one as the organ is functionless. Consent for this operation can often be obtained when castration is refused. Its chief value is in those cases where the second testis has already been removed or is the seat of advanced disease Epididymectomy is contra indicated (1) in cases of advanced genito-urinary tuberculosis, (2) when the testis is badly diseased and sinuses have formed.

(c) *Orchidectomy*—It is a question for consideration in all cases of tuberculous epididymo-orchitis in which the disease is limited to the testis whether early castration is not the best treatment. The loss of one testis is no real disadvantage to the patient while the risk of a general genito-urinary tuberculosis is a matter of supreme importance It cannot be gainsaid that a large number of patients with chronic tuberculosis of the epididymis recover and remain well if general constitutional treatment for tuberculosis is efficiently carried out but in many cases the disease progresses to other parts of the genito-urinary tract, leading ultimately to the death of the patient. This result may be prevented by an early orchidectomy

When castration is performed for tuberculous disease the cord and vas should be removed as high as possible and it is usually advisable to remove the vesicula seminalis at the same operation

Tuberculous Epididymo-Orchitis in Children

Tuberculous disease of the testis is rare in children only nine cases being diagnosed in the London Hospital in children under the age of 12 out of 11 493 patients under that age The disease has been seen a few weeks after birth. It is usually insidious in onset, and presents the same physical signs as in the adult, but associated disease of the vesiculæ and prostate is uncommon. The disease starts in the epididymis, which it probably reaches through the blood-stream It

is, however frequently associated with tuberculous peritonitis and, according to some authors with tuberculosis of the vertebræ (Pott's disease)

Prognosis is bad, the inflammation usually ending in suppuration and sinus formation.

Treatment.—This does not differ from the treatment of the disease in the adult but early castration is to be advised, to prevent if possible, infection of the peritoneum. Local scraping and epididymectomy are unsatisfactory in these small testes.

Syphilitic Epididymo-Orchitis

Syphilis affects the testis in the secondary intermediary tertiary and inherited varieties of the disease but is most commonly met with in the intermediary stage, i e *two to four years after infection.*

During the early secondary stage the epididymis is chiefly affected, the patient suffering from a symmetrical subacute epididymitis which is painless and mainly localized to the globus major The condition is rare but probably frequently passes unnoticed among the other manifestations of secondary syphilis.

In the intermediary and tertiary stages the body of the testis is *chiefly affected* the lesion being a *chronic orchitis ending either in* gumma formation or in diffuse fibrosis and later atrophy of the testis These two conditions frequently occur together the organ on section showing a general fibrosis with small gummata.

Physical signs.—In a well marked case of syphilitic orchitis (*see* Plate 45 Vol. I facing p 794) the following physical signs are present The skin of the scrotum at first normal becomes adherent to the front of the testis and later if the disease is untreated, a large piece of the skin sloughs away exposing the characteristic wash leather slough of a gummatous ulcer Through the hole in the skin thus made the testis may fungate. The body of the testis is at first uniformly enlarged and painless but later if multiple gummata form it may become nodular The organ feels lighter than a neoplasm and testicular sensation is lost early The epididymis vas deferens, and spermatic cord are usually normal, but thickening of the vas and gummata of the epididymis have been described If the epididymis is unaffected it is frequently difficult to differentiate it from the enlarged body Rectal examination reveals no lesion of the vesiculæ and prostate and there is no enlargement of the abdominal glands. A hydrocele is present in the early stages in the majority of cases (Plate 106 Fig 1) and it may be necessary to draw off the fluid before the physical signs of syphilitic orchitis can be made out Later the fluid may be absorbed and the cavity of the tunica vaginalis completely obliterated by adhesions. If a



Fig. 1.—Tertiary syphilis (gumma) of the testis with localized hydrocele. (Spec. no. [illegible], *London Hospital Museum.*)

Fig. 2. Teratoid tumour of the testis (fibro-cystic disease). (Spec. no. [illegible], *London Hospital Museum.*)

PLATE 106.

occur from various causes. It may be due to interference with the blood supply by injury to the vessels of the cord either by accident or operation to lesions of the central nervous system, either cord or brain to pressure from an old-standing hydrocele or hernia or it may be associated with some grave constitutional disease such as diabetes or leukæmia. The testis in this form of atrophy feels soft and flabby and on microscopical examination shows fatty degeneration of the essential cells without increase in the fibrous connective tissue The epididymis shares the atrophy

Both forms of atrophy of the testis, if bilateral are associated with complete or relative sterility In advanced cases spermatozoa are completely absent from the semen (azoospermia) or are few in number (oligospermia) and if the atrophy is complete, and especially in degeneration atrophy the patient is impotent.

Atrophy of one testis has no effect on sexual life provided the other testis is healthy

Treatment must be directed to the cause for the condition itself nothing can be done.

ARREST OF DEVELOPMENT

Arrest of development of the testis must be carefully distinguished from atrophy It is usually found associated with malposition of the testis; in fact, all misplaced testes are maldeveloped testes. This arrest of development of the testis is congenital, and may affect both the internal and external secretions. Usually it interferes with the external secretion only for cryptorchids generally develop the secondary sexual characters of the male, although as a rule they are sterile. There is no treatment for this condition.

NEW GROWTHS OF THE TESTIS

INNOCENT NEW GROWTHS

Innocent new growths of the testis are so rare as to be pathological curiosities.

The following varieties have been described:—

(a) *Fibroma.*—A few cases have been reported, but the descriptions of nearly all of them suggest that the disease was inflammatory in origin.

(b) *Osteoma.*—It is doubtful whether true bony tumours are ever found in the testis

(c) *Myoma.*—This tumour of which two at least have been reported, is believed to arise in the remains of the gubernaculum testis.

(d) *Adenoma.*—Ticreno and Chevason have described small nodules, never larger than a pea, occurring in ectopic testes, which they think are true adenomas. They have never seen them in the normally placed organ

MALIGNANT NEW GROWTHS

Malignant growth of the testis whether primary or secondary is rare only about 0.06 per cent. of all male patients admitted to the

one part through this the tumour if not removed will eventually fungate. The glands affected first are the lumbar glands situated on the front of the lumbar vertebræ and surrounding the aorta and the vena cava just below the level of the renal arteries and veins. A large deep-seated mass is felt on one side of the spinal column near the umbilicus. This mass is fixed and nodular and does not move on respiration. Pressure on the vena cava may lead to dilatation of the superficial veins of the abdomen and later to ascites and to œdema of the lower extremities. Occasionally the inguinal and external iliac glands are affected. Metastasis may occur to any part of the body but is most common in the lungs.

Diagnosis has to be made from hæmatocele, hydrocele chronic orchitis, and tuberculous disease. From hæmatocele the diagnosis is often extremely difficult, especially if there is no history of accident. In such cases exploratory incision is advisable before orchidectomy is *performed*.

Prognosis.—The prognosis is extremely grave largely owing to the late stage of the disease at which the patient usually comes under observation. Early removal sometimes results in complete freedom from recurrence.

Treatment.—The radical treatment of malignant disease of the testis is removal of half the scrotum, the testis, the spermatic cord, the vas, the spermatic vein up to its entrance into the renal vein on the left side and the vena cava on the right, and the cellular tissue containing the lymphatic glands by the side of the aorta and vena cava from the renal arteries to the common iliacs. This operation is readily carried out in a thin subject by the extraperitoneal route if undertaken before there is any clinical enlargement of the glands, but in stout subjects is very difficult. It is contra indicated if the glands can be felt to be enlarged before the operation. Many surgeons prefer to do a much more limited operation and confine themselves to removal of the testis and spermatic cord and this operation is also advisable in late cases which are fungating even if the lumbar glands are already affected.

Sufficient statistics have not yet been collected to show definitely whether the radical operation gives a much greater hope of freedom from recurrence than the more limited one. Local recurrence is uncommon.

Operation is contra indicated in cases of advanced disease with infiltration of the spermatic cord, as the growth will fungate through the wound and there may be serious difficulty in stopping hæmorrhage at the operation.

Pathology.—The difficulty of classification of new growths is perhaps more marked in connexion with the testis than with any

other organ in consequence of their great variety and complexity of structure Recent researches and observation have however done much to simplify the confusion and the following growths can now be differentiated by the microscope —

1 **Sarcoma.** (*a*) *Pound-celled* —These tumours show in every part masses of small round cells invading the normal testicular substance They are the most common form of sarcoma

(*b*) *Spindle-celled* —These tumours are much rarer than the round celled growths but show the same structure in every part of the growth.

(*c*) *Lympho-sarcoma* —These tumours show the reticular structure of lymph-glands but are hardly to be differentiated from the small round-celled sarcomas

2 **Endothelioma.**—Endotheliomas are rare but show the same histological characteristics in the testis as in other organs.

3. **Carcinoma.**—These tumours may be either columnar-celled or spheroidal-celled according as they arise in the ducts or in the glandular substance of the testis or frequently the cells may be of comparatively undifferentiated type Like the sarcomas they are uniform in structure and are exactly comparable with carcinomas in other glandular organs.

4 **Teratoid growths.** (*See* Teratomas below)

TERATOMAS

These tumours have been described under various names of these the most common are fibro-cystic disease (Plate 100 Fig 2) adenoma, chondroma chondroma complex, chondro-sarcoma chondro-carcinoma embryoma, chorion-epithelioma. These names indicate the complex nature of the growths and the extraordinary diversity of the tissues found in them examination of single specimens has led to great difference of opinion as to their nature Clinically they may show every type from a slowly growing encapsuled and apparently innocent tumour to a highly malignant growth destroying life by metastasis in a few weeks They are most common between the ages of 30 and 40

In all cases examination of some part of the tumour shows a simple fibro-cystic structure the cysts being lined with a columnar or flattened epithelium Here and there in the stroma masses of true cartilage are nearly always found but other parts of the tumour may show a sarcomatous carcinomatous endotheliomatous or chorio-epitheliomatous structure The metastasis may also show the simple fibro-cysto-chondromatous structure but in other cases it may be sarcomatous, carcinomatous or chorio-epitheliomatous

It is probable that these growths arise in sex cells which are attempting to develop under some unknown stimulus.

Clinically the only diagnosis possible is malignant disease of the testis, and early removal of the testis with the spermatic cord and lumbar glands is indicated in all cases, no matter how slow growing the tumour may be.

DERMOID TUMOURS

Under this term several entirely different conditions have been described —

(a) Cases of malignant teratoma, which are described above.

(b) Pilo-sebaceous dermoids arising in the skin of the scrotum and attached to the testis, but not in or of it.

(c) Tumours encapsuled in the testis and containing hair teeth, bone etc.

If the term dermoid of the testis is to be retained it should indicate this last variety only These tumours are very rare not more than three or four having been described in England in the last five-and twenty years. They are congenital in origin, but may not be recognized until the patient has reached adult life, and are of very slow growth. At any time during their existence, but particularly at puberty they may become inflamed and suppurate, discharging hair teeth, pieces of bone, etc., and so making the diagnosis easy They should be removed as soon as diagnosed.

MALIGNANT DISEASE OF THE EPIDIDYMIS

Malignant disease of the epididymis is rare, only five cases being found in the London pathological museums. The growth is usually a sarcoma, either round or spindle-celled, but a case of primary squamous-celled carcinoma has been described.

The treatment is removal of the testis as soon as the diagnosis is made.

CYSTS OF THE EPIDIDYMIS

Cysts of the epididymis have been divided into two classes (a) small superficial cysts, frequently multiple and bilateral, occurring in men over 40 rarely growing larger than a pea and seldom containing spermatozoa (b) large cysts growing in the substance of the epididymis, usually single, occurring in men under 40 growing slowly perhaps reaching the size of a small orange, and frequently containing spermatozoa (spermatoceles) It is doubtful however if these two classes are distinct from one another and as the exact pathology of cysts of the epididymis is uncertain, it is unnecessary to make the division.

Pathology—The probability is that these cysts do not all arise in the same way The following views of their origin have been propounded —

1 They are retention cysts of the tubules of the epididymis or vasa efferentia 2. They arise in fœtal remnants such as the paradidymis (organ of Giraldès) the vas aberrans the remains of Müller's duct, or the pronephros (hydatid of Morgagni) This view would make them analogous to some cysts of the ovary and embryonic in origin 3. They are due to bursting of an excretory tubule into the connective tissue round the epididymis. 4 They form in the connective tissue and have a secondary connexion with the excretory tubules.

Pathological anatomy—Cysts of the epididymis most commonly occur in the region of the globus major and extend upwards into the cord, depressing the body of the testis so that it lies more horizontally than usual (Fig 570) They are frequently bilateral and may be multiple and loculated. They vary in size from a pin's head to a cyst containing five or six ounces of fluid and are usually of very slow growth The fluid contained in them is either (a) a pale limpid fluid with only a trace of albumin, or (b) a milky white opalescent fluid containing some albumin and many spermatozoa either living and active or dead and disintegrating it is usually the large cysts that contain spermatozoa The cyst may persist in spite of several tappings or may disappear entirely after tapping

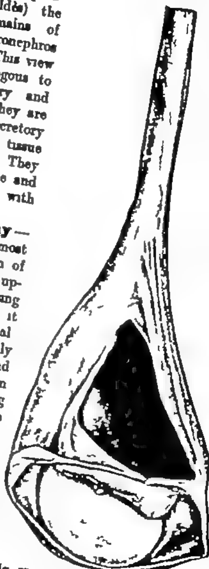
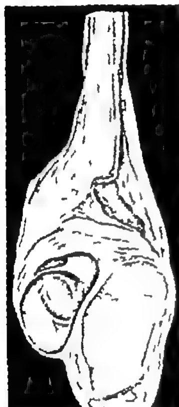


Fig 570.—Cyst of the epididymis

There is usually a connexion between these cysts and the tubules

of the epididymis or vasa efferentia on the other hand, there are many cases in which no such connexion can be demonstrated by injection or dissection.

Symptoms.—As a rule symptoms are absent although there may be some pain. Usually attention is drawn to the cysts by chance, or by their gradual enlargement They have frequently been mistaken for extra testes. They mostly occur in middle life or old age, and are of no importance. When of medium size, such a cyst presents on examination a rounded or lobulated, translucent and painless cystic swelling in the globus major it is attached to and moves with the body of the testis, which is more horizontal than usual.



In small cysts difficulty in the recognition of translucency and apparent solidity owing to tenseness may confuse the diagnosis large cysts may envelop the testis and simulate hydroceles of the tunica vaginalis, but may be distinguished from them by the fact that on careful examination the testis can usually be found below and free from the cystic swelling. The cyst may suddenly increase in size and become painful after a slight blow this may be the first intimation to the patient that he has a pat condition in the scrotum.

OTHER CONDITIONS OF THE TESTIS

NEURALGIA

This term is applied to a painful condition of the testis usually occurring in paroxysms.

The cases have been classified as follows —

(a) *Cases without an obvious lesion* —These cases, though rare exist The testis is the seat of paroxysms of acute pain although examination *in situ* or after removal fails to show any obvious abnormality The pathology is quite unknown, but there may be a history of sexual irregularities or excesses.

(b) *Cases with a lesion in the body or epididymis* —The most common of these lesions are small nodules of fibrous tissue in the globus minor of the epididymis the result of a gonorrhœal epididymo-orchitis. The nodule is usually acutely tender and the pain radiates from it. Other lesions are small cysts of the epididymis, fibrosis of the body atrophy of the testis, and the results of injury to the testis. In the case of chronic epididymo-orchitis the pain is perhaps due to retention of semen behind the blocked tubules of the epididymis.

(c) *Lesions in the adnexa of the testis and elsewhere* —The two most common lesions of this variety are varicocele and renal or urethral stone. Pain in the testis in varicocele is not an uncommon symptom, although it may be entirely absent whilst pain radiating to the testis is one of the classical symptoms of renal colic. Other conditions with which intense testicular pain is sometimes associated are hydroceles, small fibrous and cartilaginous tumours in the tunica vaginalis, and pressure on the nerves by a new growth of the spine

Symptoms.—In most cases there is constant tenderness of the testis, exaggerated during the paroxysms of pain, and usually extremely severe in any nodule that may be present either in the testis proper or in the epididymis. The paroxysms are frequently caused by exercise slight injury and changes of temperature. Coitus in some cases relieves the pain, but in others it appears to induce the paroxysms. The pain starts in the testis, and may radiate along the spermatic cord to the lumbar region. It is usually so severe that the patient is incapacitated, and it has sometimes induced self mutilation. During the paroxysms, which may last from a few minutes to several hours, the testis is frequently retracted owing to spasm of the cremaster muscle.

Treatment.—The first step in treatment is to remedy any pre-existing disease in the testis and its adnexa. A varicocele should be ligatured, cysts of the epididymis removed a hydrocele operated upon, and so forth. The removal of the pathological condition is frequently followed by complete relief of all symptoms, and no further treatment

of the neuralgia is necessary In other cases relief of the pain does not follow the treatment of the underlying condition, or there may be no apparent organic lesion in the testis. The prognosis in these cases is not good, as the condition is very rebellious to treatment, which is mainly empirical. Relapses after apparent cure are common. During the attacks of pain the patient should be put at rest in the horizontal position and the testis be supported by a suspensory bandage. Local application of cold or heat should be tried or mild counter-irritation of the scrotum employed. In severe attacks it is necessary to give morphia to relieve the pain quinine and aconite have been employed for the same purpose.

Firm pressure of the spermatic cord against the symphysis pubis for fifteen minutes has been followed by relief of pain.

The general health should be considered and especially the question of sexual hygiene, as some cases are dependent either upon sexual excesses and irregularities or upon sexual continence

Operative treatment.—The operative treatment other than relieving any obvious pathological condition consists in removal of the testis. Its advisability is doubtful. Cases are recorded by the older writers, such as Cooper Curling, and Blizard but the results were not all satisfactory In some of the cases in which relief followed the testis was the seat of obvious disease and the operation was justifiable but when no lesion exists, removal of the testis has been followed by recurrence of the pain in the spermatic cord or even in the other testis. Castration may therefore be recommended if an obvious lesion of the testis is present which cannot be remedied in any other way but if no lesion exists the operation is unlikely to effect a cure In all cases the patient should be warned of the uncertainty of relief following castration.

SPERMATORRHŒA

This term implies a frequent escape of seminal fluid at other times than during a sexual orgasm. As a pathological condition if it exists, it is exceedingly rare Escape of seminal fluid not infrequently occurs during defæcation, especially if there is much straining at stool with the passage of hard fæces. It occurs in men who lead a continent life, and is a purely mechanical effect, the fæcal mass squeezing against the contents of the seminal vesicles, which are between the rectum and the bladder It is a perfectly natural and harmless phenomenon. Spermatozoa may also be found in the urine which is first passed after coitus or an emission

Patients who have for a long time indulged in sexual excesses or masturbation not infrequently increase the irritability of the sexual organs to such an extent that emission takes place on very slight

provocation and often with incomplete erection of the penis and a minimum of pleasurable feeling but this is a condition of irritability of the sexual apparatus with frequent emissions not spermatorrhœa.

Some patients also suffer from frequent nocturnal emissions but here again the term spermatorrhœa is not applicable erection and orgasm being present.

The alleged disease is one that is firmly believed in by the laity and the following conditions frequently give rise to the fear that the patient is suffering from a dreaded disease which only exists in his imagination —

1 Escape of a little prostatic fluid after sexual excitement accompanied by complete or partial erection of the penis.

2 Frequent nocturnal emissions.

3. Escape of muco-pus in a patient who has a general or localized urethritis prostatitis or vesiculitis, or Cowperitis

4. Deposits of urates or phosphates from the urine more especially the latter which sometimes appear as a milky deposit at the end of micturition.

5. The normal mucous cloud in urine.

Among the insane complaints of spermatorrhœa are frequently made and they may be attributed by the patient to past masturbation or sexual excesses but the condition only exists in the diseased imagination

To sum up the term spermatorrhœa is a misnomer and should be discarded from medical literature.

Nocturnal Emissions

The occurrence of emission of semen during sleep may be either physiological or pathological. In healthy adult men living well as regards food and drink, and leading a continent life nocturnal emissions accompanied by voluptuous dreams and erection of the penis are natural if they do not occur more frequently than once in ten days or a fortnight, and are not accompanied by any bad reaction on the general health. They are pathological if they occur more frequently —for example several nights in succession or several times in the same night if they are not accompanied by full erection of the penis or if they cause the patient to feel weak, irritable and easily tired Pathological nocturnal emissions usually follow sexual excesses, habitual masturbation irritation from a tight prepuce or inflamed prostate, or unhealthy sexual excitement or they may be the result of organic disease such as myelitis tabes dorsalis, or general paralysis of the insane

Treatment.—If on careful consideration of the history and the effects of the emissions, the condition is considered physiological the

patient should be frankly assured that the condition is natural and no treatment is necessary For frequent emissions with bad after effects, the treatment consists in careful sexual hygiene after treatment of any local condition such as phimosis. The diet should be spare and unstimulating, and alcohol is to be avoided especially in the evening Mental occupation, with a sufficiency of healthy outdoor exercises, and the avoidance of prurient thoughts and literature, are all important. Engorgement of the prostate in the early morning, due to the full bladder is a source of irritability and can be readily removed by emptying the bladder immediately on waking Cold sponging of the genitals or cold baths are also useful. Drugs other than aperients are of little use, but general tonics may be useful. Sedatives such as bromide of potassium, hyoscyamus, cannabis indica or opium may be tried, but they are of little use without careful regulation of the sexual life

THE SPERMATIC CORD AND TUNICA VAGINALIS

HYDROCELE

Hydroceles may be either primary or secondary and it is advisable to discuss the latter first.

Secondary Hydrocele

This form of hydrocele may be divided into acute and chronic.

1 *Acute secondary hydroceles* are generally due to inflammations or injuries of the testis, the most common being gonorrhoeal epididymo-orchitis, but they also occur with the orchitis of the specific infective fevers. These hydroceles are cases of *vaginalitis* the inflammation of the tunica vaginalis being secondary to the inflammation of the testis and the effusion inflammatory in origin and nature. The condition is frequently unnoticed as it is masked by the symptoms of the acute inflammation of the testis and the treatment is identical with the treatment of the primary inflammation. Resolution is by far the commonest result, but suppuration occurs in a certain number of cases, and the tunica has to be drained (*see* Acute Epididymo-Orchitis, p 979) Acute hydroceles also occur with acute inflammation of the scrotum or spermatic cord, or they may be secondary to acute torsion of the testis. In this latter condition the fluid is usually blood-stained.

2 *Chronic secondary hydrocele* is also generally due to a chronic vaginalitis secondary to chronic inflammation of the testis, as in tuberculous epididymo-orchitis and syphilitic orchitis.

In some cases chronic hydroceles are passive effusions into the cavity of the tunica vaginalis as in cases secondary to neoplasm of the testis.

The treatment of secondary hydrocele is that of the primary condition, but in the case of hydrocele secondary to syphilitic orchitis tapping or radical cure may be necessary

PRIMARY HYDROCELE

The primary form of hydrocele may be acute or chronic. Acute primary hydrocele due to an acute vaginalitis is rare but cases have been described of acute pneumococcic and other infections of the tunica vaginalis with effusion of inflammatory lymph into the tunical cavity and it is possible that acute rheumatic vaginalitis occurs.

Chronic hydrocele may also be due to a chronic vaginalitis such as tuberculous infection of the tunica, which is most common in children and is frequently associated with tuberculous peritonitis but the pathology of the common vaginal hydrocele is unknown, and it will be described under the title of primary idiopathic hydrocele.

1 *Primary Idiopathic Hydrocele of the Tunica Vaginalis*

Two views are held as to the causation of this disease (1) that it is secondary to a chronic inflammation of the testis or epididymis (2) that it is a passive effusion into the cavity of the tunica vaginalis from unknown causes.

Of these two views the latter is the one most generally held by English surgeons while the former is favoured by French surgeons.

The condition is most frequently met with in elderly patients, and especially in persons resident in the tropics but it may occur at any age

A preceding or accompanying history of inflammation of the testis or epididymis is unusual, the patient rarely giving any cause for the disease

Pathological anatomy *Fluid*—The usual amount of fluid in a primary hydrocele is about half a pint, but occasionally hydroceles are seen containing quarts of fluid. The fluid closely resembles blood serum its specific gravity is about 1022 and it contains about 6 per cent. of albumin the fluid becoming solid on boiling It is generally straw-coloured but may be brownish from admixture of blood, or may sparkle from the amount of cholesterin in it. It contains fibrinogen and therefore coagulates on the addition of blood or other source of fibrin ferment.

Tunica vaginalis—The tunica vaginalis even in old-standing cases may be simply thinned owing to the pressure of the fluid and show no other feature On injection with soft paraffin long finger like processes may sometimes be seen projecting into the connective tissue of the scrotum In other cases thickening of the tunica occur-

causing the hydrocele to be constricted in places, or even loculated. In old cases, especially those that have been tapped many times, fibrosis of the tunica may be present, and in some instances the walls of the sac are as much as half an inch in thickness. Calcification of these thickened sacs, which are often of cartilaginous hardness, is not infrequent. In rare instances, projecting from the walls of the sac or lying free in the cavity are small cartilaginous or fibrous bodies. In a few specimens, inflammatory adhesions may partially obliterate the cavity of the tunica and localise the hydrocele to one part.

Testis—In longstanding cases, thickening of the tunica albuginea with atrophy of the testis may be present, due to the pressure of the fluid, but this is rarely important In some cases the distension of the digital fossa of the tunica with fluid lifts the epididymis away from the body of the testis, and thus thins out the vasa efferentia, which may be so pressed upon as to prevent escape of spermatozoa from the gland and in this way double hydrocele in a young subject may lead to sterility In some longstanding cases the testis is so squeezed out and incorporated with the wall of the hydrocele that it is not immediately discoverable on opening the hydrocele.

Spermatic cord—This is sometimes a little thickened from hypertrophy of the cremaster fibres.

Penis—In large hydroceles the skin of the penis and scrotum may be so dragged forward that the penis is lost in it, and only represented by a dimpled fold of skin resembling the umbilicus.

Symptoms—The patient rarely complains of pain, but only of the discomfort and weight of the distended scrotum or the difficulty of micturition and inconvenience if the penis is buried.

On examination a pear-shaped swelling with base downwards is found distending one-half of the scrotum. The skin of the scrotum is unaffected and the fingers can get above the swelling and grasp the cord showing that there is no communication with the abdomen Usually the scrotum can be readily folded up on to the abdomen. The swelling is found to be translucent, but several fallacies in connexion with this sign may occur In the first place, translucency is absent if the walls are very thick or calcareous, or if hæmorrhage has occurred (hæmatocele) in the second place, translucency may be present in a hernia of a child if it contains gut distended with gas.

The testis, when distinguishable, is usually found below and behind the fluid, but in cases of inversion of the testis it is found in front—a point of great importance when the hydrocele has to be tapped The swelling is usually plainly cystic to the touch, and has no expansile impulse on coughing The affections most likely to cause errors in diagnosis are hæmatocele cysts of the epididymis or testis, scrotal hernias and neoplasms of the testis and the condition may be

complicated by the presence of cysts of the epididymis hydrocele of the cord or hernia.

Complications. (*a*) **Rupture.**—This may be traumatic or spontaneous in the latter case it may occur while the patient is quietly resting, and is probably due to the giving way of one of the finger-like processes described above or of the wall at the site of a previous tapping There is a sharp sudden pain followed by alteration in the condition of the scrotum the definite cystic swelling changing to a diffuse œdematous condition often with evidence of blood extravasation. The penis prepuce and the other half of the scrotum usually become swollen. The pain as a rule steadily increases, and causes the patient to seek relief. Spontaneous cure suppuration or recurrence of the hydrocele may follow

(*b*) **Inflammation and suppuration.**—These terminations are rare and are usually due to definite injury although this is not absolutely necessary

(*c*) **Transformation into hæmatocele** may be due to either tapping or injury or may occur spontaneously and insidiously

Treatment.—Treatment may be palliative by tapping, or curative by radical operation Treatment by injection of various irritants into the sac is obsolete

Tapping —A hydrocele may be tapped as often as it becomes inconvenient on account of its size. The position of the testis should always be ascertained before tapping, either by noting its position when the translucency test is applied, or in the case of small hydroceles by feeling it The skin of the scrotum is cleaned in the manner usual for all operations, and drawn tensely over the swelling with one hand whilst with the other the aseptic trocar and cannula is plunged through it into the cyst the puncture being usually made in front, but always away from the testis. Care should be taken to avoid any superficial scrotal veins. The fluid is then drawn off, the cannula removed, and the small puncture closed with a little collodion. In a few cases no recurrence follows tapping, but as a rule it has to be repeated at intervals.

Radical cure.—This can be advised in all cases except when the patient is elderly or debilitated in health, and it is usually completely successful though recurrence has been recorded. Two operations are advised, and it is immaterial which is chosen—(*a*) excision of the tunica vaginalis lining the scrotum, or (*b*) inversion of the sac

(*a*) *Excision of the tunica vaginalis lining the scrotum.*—It is doubtful if the old division into a parietal and a visceral layer of the tunica vaginalis can be maintained Some authorities consider that the body of the testis is uncovered by a serous membrane, but that the organ projects into the cavity of the tunica vaginalis in the same way that

the ovary projects into the peritoneum (Fig 572) If this is so excision of the tunica vaginalis lining the scrotum means complete excision of the tunica and recurrence is most unlikely

The operation is a simple one, and is easily performed through a two-inch incision over the external abdominal ring Care should be taken to arrest all hæmorrhage even from the smallest bleeding-points, otherwise a troublesome hæmatoma may result

(b) *Inversion of the sac.*—The tunica is opened the fluid allowed

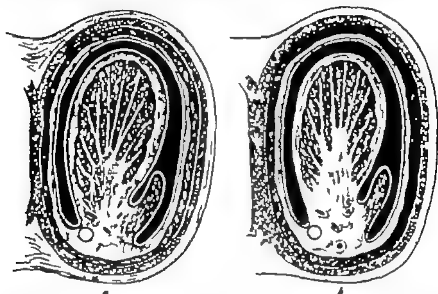


Fig 572.—Diagram illustrating the two theories regarding the relationship of the tunica vaginalis to the testis.

a, Tunica vaginalis covering the testis and lining the scrotum b, tunica vaginalis lining the scrotum, but not covering the testis.

to escape and the sac simply inverted with or without suture. Recurrence is rare

Treatment of rupture—Rupture may either be treated by rest and support until the œdema has disappeared when a radical cure may if necessary be performed or the operation may be done as soon as the patient comes under observation. The former as less liable to be followed by complications, is probably the better course to pursue.

Treatment of suppuration—As in cases of suppuration elsewhere *the abscess cavity should be opened and drained.*

2. *Infantile Hydrocele* (Fig 573, 1)

In this variety of hydrocele the processus vaginalis is closed above at the internal abdominal ring, but the part lying in the cord

that normally should be obliterated remains patent and becomes filled with fluid. The condition is common and appears soon after or at birth.

Physical signs.—A fluid swelling extending from the inguinal canal to the bottom of the scrotum translucent and not reducible.

Treatment.—If left alone the hydrocele frequently disappears spontaneously or it may not return after tapping several times. It is very seldom necessary to perform a radical cure by dissection.

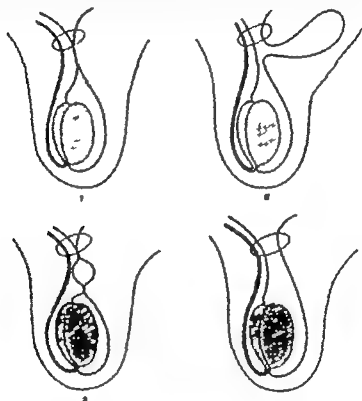


Fig. 673.—Diagrams of varieties of hydrocele.
1, Infantile; 2, bilocular; 3, encysted hydrocele of the cord; 4, congenital.

3. *Bilocular Hydrocele* (Fig. 673, *2*)

The bilocular hydrocele shows two pouches—one running down into the scrotum and having the relationships of an infantile hernia and the other extending up into the abdomen either behind or in front of the peritoneal cavity. The abdominal pouch may be very large and extend above the umbilicus and down into the pelvis. The condition is rare. Hæmorrhage may occur into the sac and form a bilocular hematocele.

Symptoms.—The diagnosis will be made by finding an infantile

hydrocele which has a communication with a cyst lying above Poupart's ligament.

Treatment.—The hydrocele may be tapped but it is better to remove it by dissection The constriction between the two sacs usually occurs at the inguinal canal.

4. *Diffuse Hydrocele of the Cord*

This is a very rare condition the cause of which is unknown. It is a collection of fluid, resembling blood serum in composition in the meshes of the connective tissue of the spermatic cord

Symptoms.—The patient exhibits a pyriform swelling, the base of which rests on the top of the testis, whilst the apex disappears into the external abdominal ring The swelling is painless and disappears under slight continuous pressure but reappears directly the pressure is removed The condition is somewhat difficult to diagnose from an omental hernia.

Treatment.—The hydrocele may be tapped and the fluid withdrawn but it soon returns. Radical cure consists of incision and drainage.

5 *Encysted Hydrocele of the Cord* (Fig 573 3)

Although cysts may arise in the spermatic cord from several causes, the above term is given to a cyst formed by fluid collecting in an unobliterated portion of the processus vaginalis which is closed above and below These cysts are usually found in children, but may be discovered at any age.

Symptoms.—The condition presents itself as a small, rounded freely movable translucent cystic swelling, situated in the cord between the testis and the external abdominal ring The cyst moves with the testis and cannot be completely reduced into the abdomen. In some cases the cysts are multiple and may communicate with the peritoneal cavity Hæmorrhage may occur into such an encysted hydrocele, converting it into an encysted hæmatocele of the cord

Treatment.—In young children the cyst may disappear spontaneously or after tapping, but if a radical cure is considered advisable the cyst should be dissected out.

6 *Congenital Hydrocele* (Fig 573 4)

A congenital hydrocele which is not necessarily manifest at birth, is an effusion of fluid into an entirely unobliterated processus vaginalis. It may be present on one or both sides if bilateral, causes for increase of fluid in the peritoneal cavity such as tuberculous peritonitis and cirrhosis of the liver should be sought, the hydrocele merely representing an overflow from this cavity

Physical signs.—There is a translucent pyriform swelling in the

scrotum lying in front of the testis and running up into the abdomen There is frequently an impulse when the patient coughs or cries By steady pressure the fluid can be returned into the abdomen but the sac soon refills when the patient stands upright The diagnosis has to be made from congenital hernia, with which however it may be complicated.

Treatment.—As the condition always represents a potential hernia it should be treated as a hernia. A truss must be worn constantly for two years, and the hydrocele must be tapped occasionally As this treatment is irksome, a radical cure as for a congenital hernia is better and surer

HÆMATOCELE OF THE TUNICA VAGINALIS

By this term is meant an extravasation of blood into the cavity of the tunica vaginalis. The condition is not common.

Etiology—In the majority of cases a hæmatocele is preceded by a hydrocele but this is by no means necessarily so although French writers generally believe that previous inflammatory conditions of the tunica vaginalis are nearly always present before the onset of the hæmatocele.

1 **Spontaneous origin.**—In some cases of hæmatocele the condition appears to arise without any cause The most careful questioning both before and after the diagnosis is established fails to elicit any history of injury strain, or previous disease of the testis or its covering, and examination of the testis after removal gives no clue to the origin of the hæmatocele It is possible in these cases that the blood vessels are primarily at fault but this has still to be proved.

2. **Injury.**—The great majority of cases of hæmatocele are due to a definite injury perhaps the most frequent being in the tapping of a hydrocele. It follows in one of two ways (a) During the tapping a vessel is injured in the tunica vaginalis which rapidly fills with blood. A warning of this may be given at the time of tapping by the escape of blood-stained fluid from the cannula. (b) A vessel may rupture after the tapping, owing to the sudden relief of pressure due to the removal of the hydrocele fluid. In these cases the swelling will rapidly return after tapping, but the physical signs will alter from those of hydrocele to those of hæmatocele Hæmorrhage into a hydrocele may also be due to a blow or to the strain of muscular effort or even coughing and for the same reason a hæmatocele may occur in the tunica vaginalis without the previous formation of a hydrocele.

3. A hæmatocele may in rare instances be secondary to a malignant new growth either of the testis or of the tunica vaginalis.

This condition is rare although small localized hydroceles are not uncommon with malignant tumours of the testis.

4. With acute torsion of the spermatic cord a small hæmatocele always forms in the cavity of the tunica vaginalis.

Symptoms.—Clinically hæmatoceles may be divided into two classes (1) acute cases which usually have a very definite history of injury and in which diagnosis is generally easy and (2) chronic cases without a definite history and in which diagnosis is always difficult and often impossible without exploratory incision

Acute hæmatocele.—The onset of these cases is sudden and follows a blow on the scrotum or a muscular strain the patient usually being the subject of a hydrocele or it follows the tapping of a hydrocele

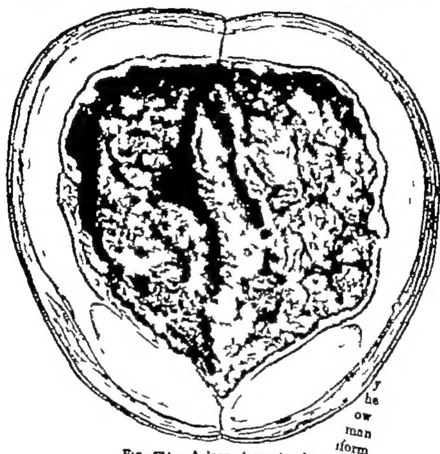
The scrotum rapidly swells, and there is generally marked ecchymosis of the scrotal skin. The swelling is painful and tender semi fluctuant and non translucent As a rule the position of the testis cannot be made out but it is usually situated below and behind the swelling Tapping causes escape of blood and diminution, but not disappearance, of the swelling If left the ecchymosis of the scrotum disappears, the pain diminishes, and the swelling gets smaller but in a few cases inflammation terminating in suppuration may occur the physical signs changing to those of a scrotal abscess. Complete resolution of a hæmatocele is rare some thickening of the tunica vaginalis and blood-clot remaining

Chronic hæmatocele.—The onset in these cases is insidious, the patient giving no history of a cause The swelling grows slowly but usually there are irregular increases in size followed by retrogression suggesting small and repeated hæmorrhages. It may be months before the hæmatocele grows to a size that is inconvenient to the patient.

The swelling is firm and feels solid, and is not tender or translucent. It is often irregular and nodular and testicular sensation cannot be obtained It is frequently impossible to ascertain the position of the testis or to differentiate between body and epididymis. The cord may be thickened, and the skin of the scrotum may not be freely movable over the swelling If tapping is resorted to no fluid may escape from the cannula, but usually there issues some dark brown or black fluid containing degenerated blood-corpuscles and cholesterin In these chronic cases as in the acute inflammation and suppuration may occur and cause a scrotal abscess.

Pathological anatomy—If a recent case be examined there may be no definite changes in the tunica vaginalis or in the testis, the only pathological condition found being blood, partly coagulated and partly fluid in the cavity of the tunica vaginalis and in the scrotal

tissues outside the tunica. In old-standing cases the tunica vaginalis is thickened sometimes to the extent of three-quarters of an inch and is covered internally with a membrane formed by organization of a layer of the blood-clot. (Fig 571) The cavity is filled with dark brown or greyish clot and a dingy brown fluid consisting of serum, blood pigment, degenerated corpuscles, and cholesterin. The tunica albuginea testis is



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Fig 571 —A large hæmatocele. is seen
the left
thickened, and there may be marked degeneratooking of
body of the testis and the epididymis, although subject
exist for years without causing any con
gland. The spermatic cord may be much the left side

Diagnosis.—The diagnosis in acut f of which are
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